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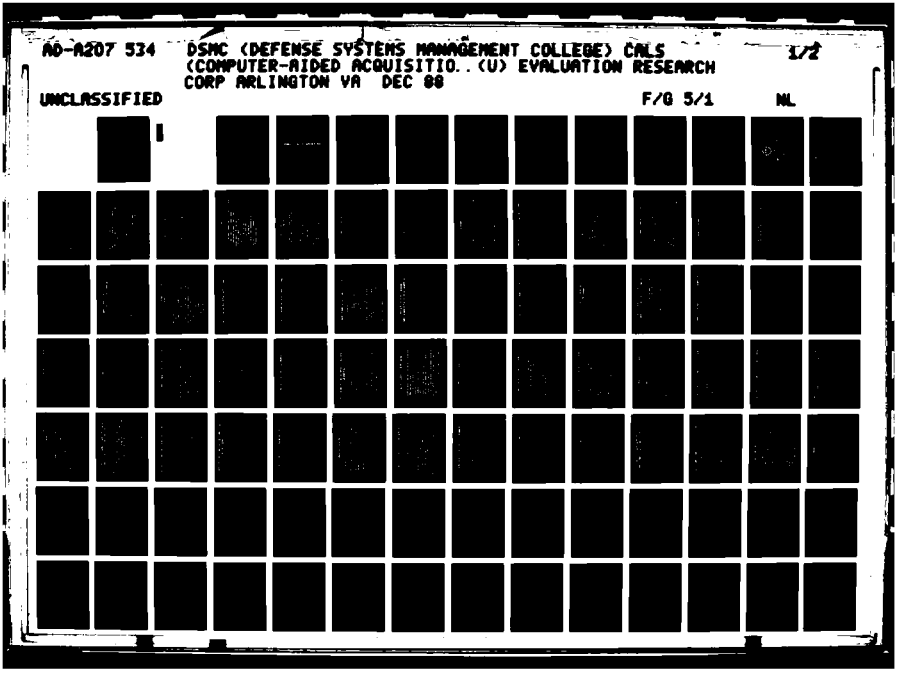

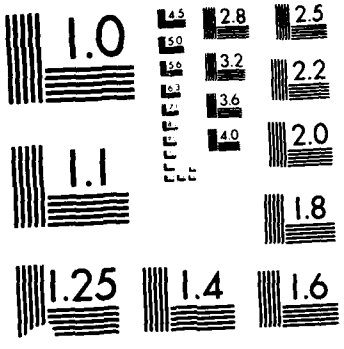

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SECURITY CLASSIFICATION OF THIS PAGE

ADB207534

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188
Exp. Date: Jun 30, 1986

1a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED	1b. RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY	3. DISTRIBUTION/AVAILABILITY OF REPORT Distribution for public release, distribution is unlimited
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE	
4. PERFORMING ORGANIZATION REPORT NUMBER(S)	5. MONITORING ORGANIZATION REPORT NUMBER(S)
6a. NAME OF PERFORMING ORGANIZATION Evaluation Research Corporation 6b. OFFICE SYMBOL (If applicable) ERC	7a. NAME OF MONITORING ORGANIZATION
6c. ADDRESS (City, State, and ZIP Code) Arlington, VA 22202	7b. ADDRESS (City, State, and ZIP Code)
8a. NAME OF FUNDING/SPONSORING ORGANIZATION Office of Asst. Sec. of Def.(P&L)/CALS 8b. OFFICE SYMBOL (If applicable) OASD/CALS	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
8c. ADDRESS (City, State, and ZIP Code) Washington, DC 20301-8000	10. SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT NO. 603736D; PROJECT NO.; TASK NO.; WORK UNIT ACCESSION NO.

11. TITLE (Include Security Classification)
DSMC CALS Briefing/Mangement of Acquisition Logistics Course (UNCLASSIFIED)

12. PERSONAL AUTHOR(S)
Material prepared by Evaluation Research Corporation

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Year, Month, Day)	15. PAGE COUNT
FINAL	FROM _____ TO _____	1988 December	145

16. SUPPLEMENTARY NOTATION
Prepared in cooperation with the Defense Systems Management College (DSMC)

17. COSATI CODES		
FIELD	GROUP	SUB-GROUP

18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
Computer-aided Acquisition and Logistic Support (CALS), CALS Standards, Logistic Support Analysis Record (LSAR)

19. ABSTRACT (Continue on reverse if necessary and identify by block number)
This material contains vugraphs and suggested narrative for a two hour module on the Computer-aided Acquisition and Logistic Support (CALS) initiative for the Management of Acquisition Logistics Course (MALC) at the Defense Systems Management College at Ft. Belvoir. It is designed to give an understanding of the nature and scope of the DoD CALS initiative; its application to weapon programs; and the benefits expected from CALS. The outline is what is CALS?; why CALS?; where are we going?; how and when will we get there?; major system/equipment implementation; technical aspects; issues; and summary. Most of the material was derived from the 1988 OSD CALS Report to the Appropriation Committee for the House of Representatives and drafts of the CALS Program Implementation Guide (MIL-HDBK-59). The material in the MALC contains the material in the DSMC CALS Briefing, Program Managers Course plus additional material on benefits and MIL-HDBK-59. Keywords:

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT	21. ABSTRACT SECURITY CLASSIFICATION
☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT. ☐ DTIC USERS	UNCLASSIFIED
22a. NAME OF RESPONSIBLE INDIVIDUAL Marion Fedorshak	22b. TELEPHONE (Include Area Code) (703) 756-8420 22c. OFFICE SYMBOL OASD/CALS

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All other editions are obsolete.

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DSMC CALS BRIEFING

MANAGEMENT OF
ACQUISITION LOGISTICS COURSE

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DECEMBER 1988

DSMC CALS BRIEFING MODULE

MANAGEMENT OF ACQUISITION LOGISTICS COURSE (MALC)

(90 - 120 MINUTES)

1. BACKGROUND

2. LEARNING OBJECTIVES, ETC.

3. SUGGESTED VUGRAPH SEQUENCE

4. VUGRAPHS

5. NARRATIVE

BACKGROUND

The attached graphics and narrative were prepared for use by the Defense Systems Management College in a two hour segment on CALS in the Management of Acquisition Logistics Course (MALC). The graphics and narrative are selectively used by the instructor for the CALS portion of this segment. Learning objectives and outcomes, were the student reading assignments prior to the lecture, student handouts, and optional reading are also attached. Students at DSMC do not receive copies of the vugraphs. This segment of the MALC is normally augmented by a CALS video tape.

This material is being released to the services and industry for use as they see fit in association with CALS implementation. The materials may be used in whole or in part since many organizations feel it desirable to add or use material specifically oriented to their command or company. The material has been "tested" for use in both the whole or part approach.

The material is taken primarily from the 1988 CALS Report to Congress and the draft DoD CALS Implementation Guide. The OSD expects to update the DSMC course material on a continuing basis since CALS will change significantly over time. The potential user of this material should take this changing picture into account in planning to use any or all of this material, which was prepared by the Evaluation Research Corporation.

December 1988

DRAFT

TECHNICAL MANAGEMENT DEPARTMENT

Subj: DoD CALS Initiative Presentation for MALC Course

Objectives:

- To provide an understanding of the scope and nature of the DoD CALS initiative, its application to DoD programs in the near term, and the possible benefits to DoD program management.

Desired Learning Outcome: Each student should receive and understanding of:

- The nature and scope of the DoD CALS initiative
- It's application to weapon programs
- Benefits expected from CALS
- Where to go for additional information

Assignments:

- August 1988 CALS policy memo (attached) SCAN. 5 minutes
- Executive Summary of 1988 CALS Repot to Congress. (Attached) SCAN. 10 minutes

Preparation Time Required: 15 minutes

Optional Reading:

- 1988 CALS Report to Congress (attached)
- Paper: Initial Graphics Exchange Specification (IGES) Capability Development for SSN-21 (attached)
- Draft DoD CALS Program Implementation Guide, library.
- Air Force Tech Order Management System - Final Report, library
- DLA CALS 1988 Implementation Plan, library.

Where to go for Additional Information:

- Industry CALS Task Force (Attached)
- DoD CALS Steering Group (Attached)
- CALS Bulletin Board (Attached)

SUGGESTED MALC CALS

MODULE VUGRAPH SEQUENCE

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DOD INITIATIVES IN COMPUTER-AIDED ACQUISITION AND LOGISTIC SUPPORT

MARYA BRAUNSTEIN
DEFENSE SYSTEMS MANAGEMENT COLLEGE

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CALS IMPLEMENTATION POLICY

(DEPSECDEF MEMO FY1988)

- Systems now in FSD or production
  - Review cost saving and quality opportunities from changing to digital delivery or access
- Systems entering development after Sep 1988
  - Require proposals for CALS data delivery or access

OUTLINE

- What is CALS?
- Why CALS?
- Where are we going?
- How and when will we get there?
- Major system/equipment implementation
- Technical aspects
- Issues
- Summary

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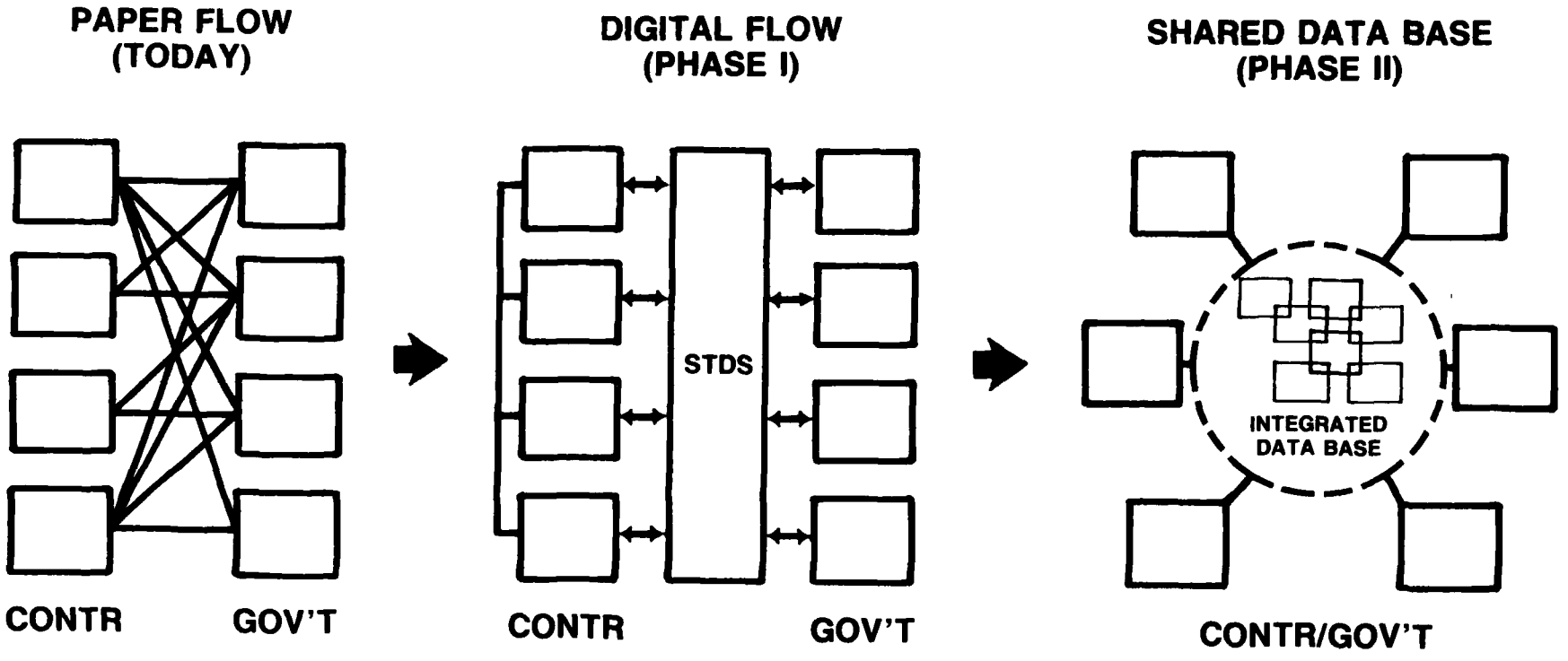
WHAT IS CALS?

CALS is a DOD and industry strategy to enable and accelerate the integration of digital technical information for weapon system acquisition, design, manufacturing and support.

CALS will provide long-term productivity and quality gains through:

- **Streamlining critical functions**
- **Eliminating redundant tasks and data**
- **Improving operational effectiveness**
- **Reducing lead times and costs**

WHAT IS CALS?



- INTEGRATION PROGRAM
- TRANSITION TO "NEAR PAPERLESS" DESIGN, MANUFACTURING, SUPPORT
- GAIN BENEFITS OF A HIGHLY AUTOMATED AND INTEGRATED SYSTEM

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SCOPE

- Technical data base definition and access
  1. Product definition data base
  2. Integrated support data base
- Digital data interchange
  *1. Product definition data
  *2. LSA/LSAR
  *3. Technical manuals
  4. Training materials
  5. Technical plans and reports
  6. Operational feedback data
- Integration of processes
  *1. R&M integration in CAD/CAE

*Major initial areas of emphasis

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WHY CALS?
EXPECTED BENEFITS

- Digital preparation and delivery
  - Elimination of redundant data
  - 20-30% expected savings in TM automation of authoring
  - 35% improvement in troubleshooting accuracy
  - $135M potential AF annual savings in tech manuals changes
- Integrated data bases
  - 20-35% savings in ILS
  - Opportunity to impact 5-10% of acquisition cost
- Redesigned processes
  - New ways of doing business
  - 20% estimated savings over weapon system life cycle

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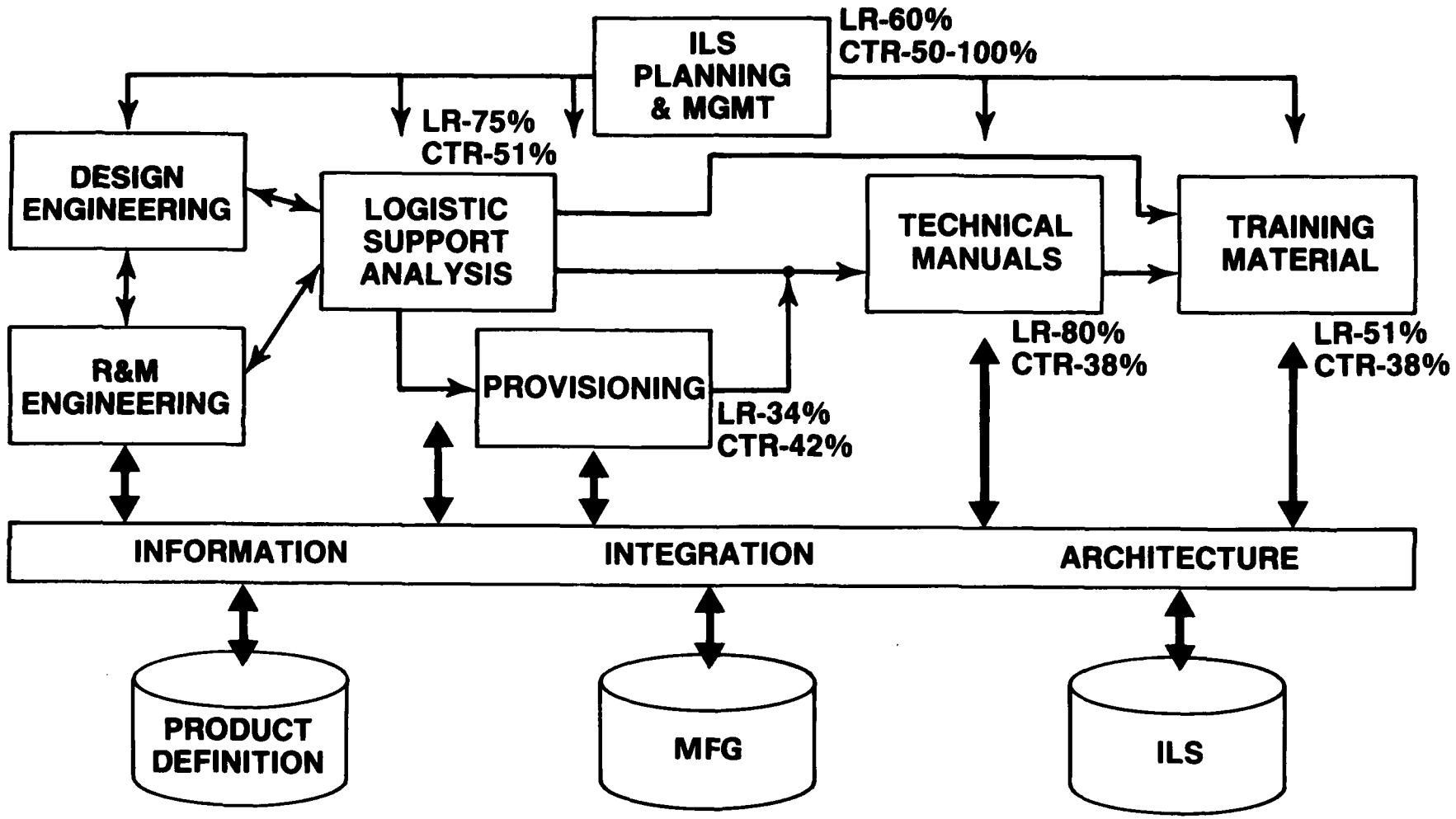
WHY CALS?



LR - LABOR REDUCTIONS
CTR - CYCLE TIME REDUCTIONS

"INTEGRATED PROCESSES - INTEGRATED INFORMATION"

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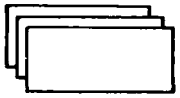
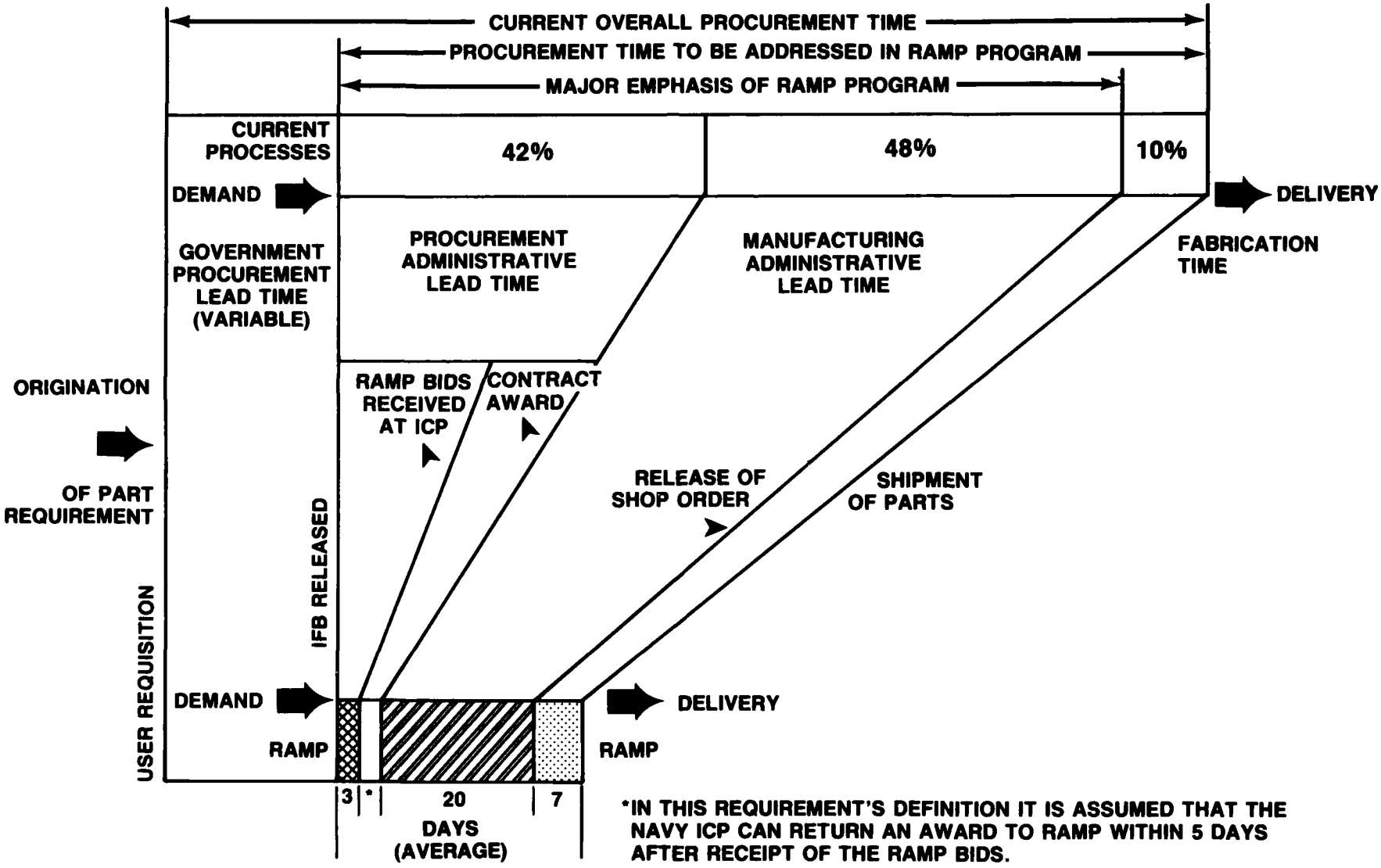
F-16 WEAPON SYSTEM STORAGE AND DISTRIBUTION COST COMPARISON (1987 PRICES)

	# OF DISCS/ PAPER REQUIRED PER SET	UNIT COST	PRODUCTION COST PER SET	SUBTOTAL PER SET	DELIVERY COST** (UPS)	TOTAL
PAGES	750,000	$21,300	—	$21,300	$750 (TRUCKING COST)	$22,050
 CARTRIDGE DISK	1,098	$70	$1,235	$78,095	$240	$78,135
CD-ROM	39	$275	$859*	$966	$4	$870
12" DOUBLE SIDED WORM	12	$400	$180	$4,980	$12	$4,992

*PRODUCTION COST BASED ON 100 SETS
**CALCULATED FOR 500 MILES

RAMP



*IN THIS REQUIREMENT'S DEFINITION IT IS ASSUMED THAT THE NAVY ICP CAN RETURN AN AWARD TO RAMP WITHIN 5 DAYS AFTER RECEIPT OF THE RAMP BIDS.

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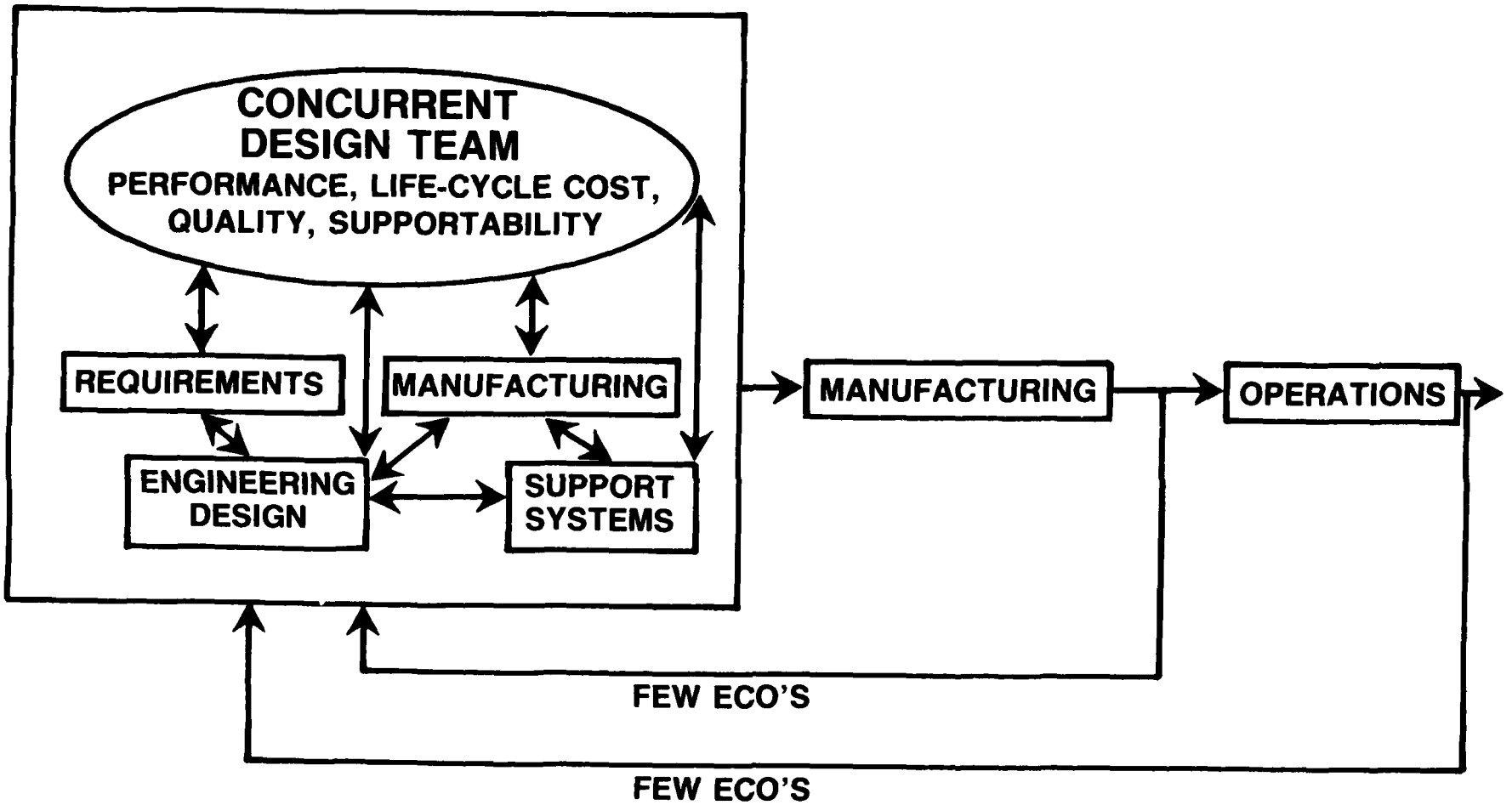
NEW WAYS OF DOING BUSINESS



- "GET IT RIGHT THE FIRST TIME"
- COMPRESSION OF DESIGN AND DEVELOPMENT TIME
- LOWEST LIFE-CYCLE COSTS

CALS STRATEGY

- Phased implementation
  - ADP modernization (DOD, industry)
  - Technology demonstrations, prototypes
  - Lead weapons system programs
  - Routine contractual implementation
- Establish unified DOD interface with industry
  - Develop "core" of interface stds, functional specs
  - Use by services as common point of departure in contracts

CALS IMPLEMENTATION

Phase I

- Focus on
  - A few major logistics applications
  - Available technology, standards
  - Primarily "records transfer" environment

Phase II

- Focus on
  - Wider range of design, mfg, logistics applications
  - More advanced technology, standards
  - Centroid is advanced product data models
  - Primarily "online access" environment

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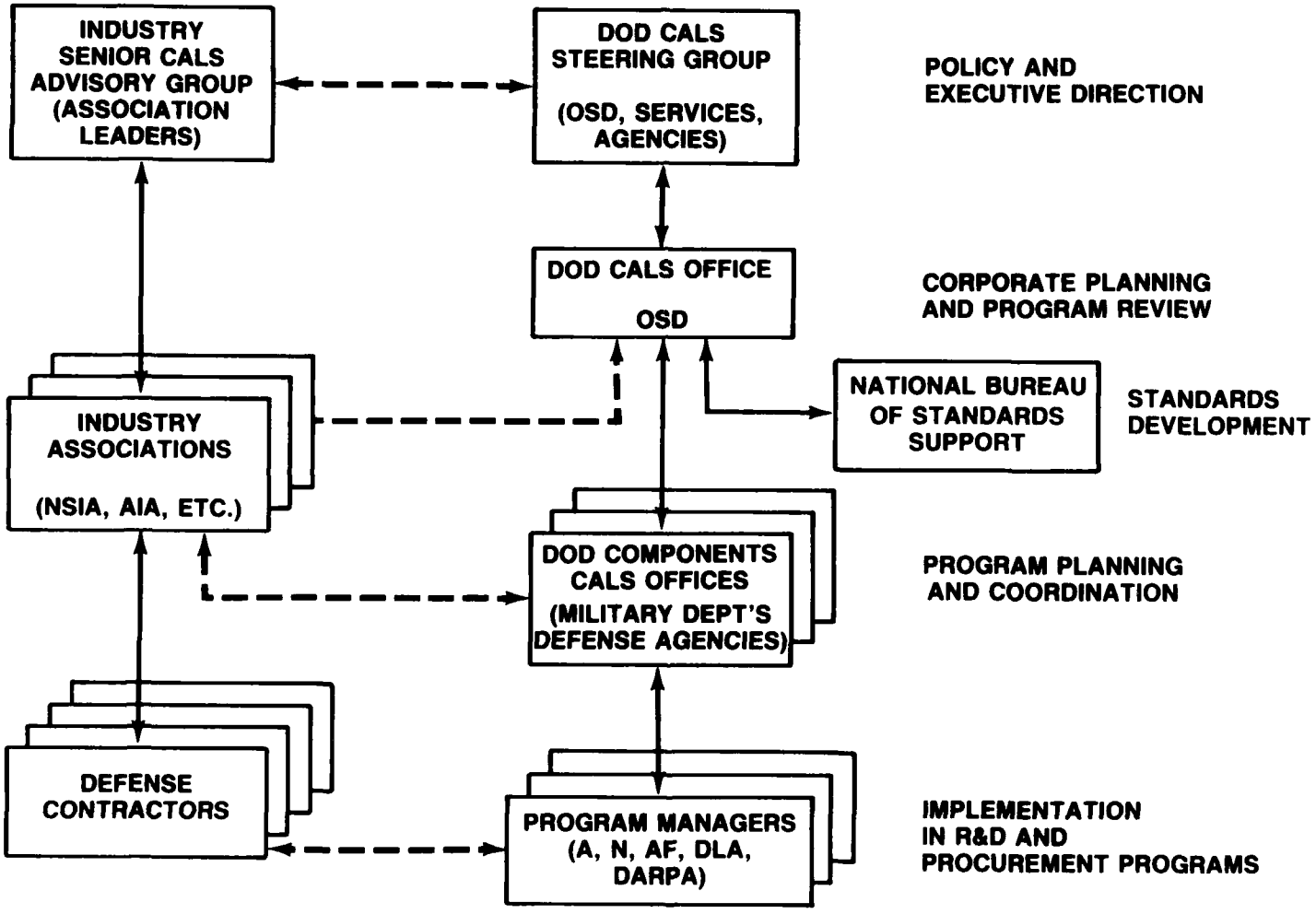
MANAGEMENT



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CALS — INDUSTRY IS A CONTRIBUTING PARTNER

- Industry is cooperating
  - Industry advisory group
  - Industry steering group
  - PDES cooperative
- Impact of CALS on industry
  - Large investment required
  - Prime-prime, prime-sub-vendor links
- Preferred mode is for DOD to adopt a common industry-developed approach
- Industry motivation
  - Essential to stay competitive

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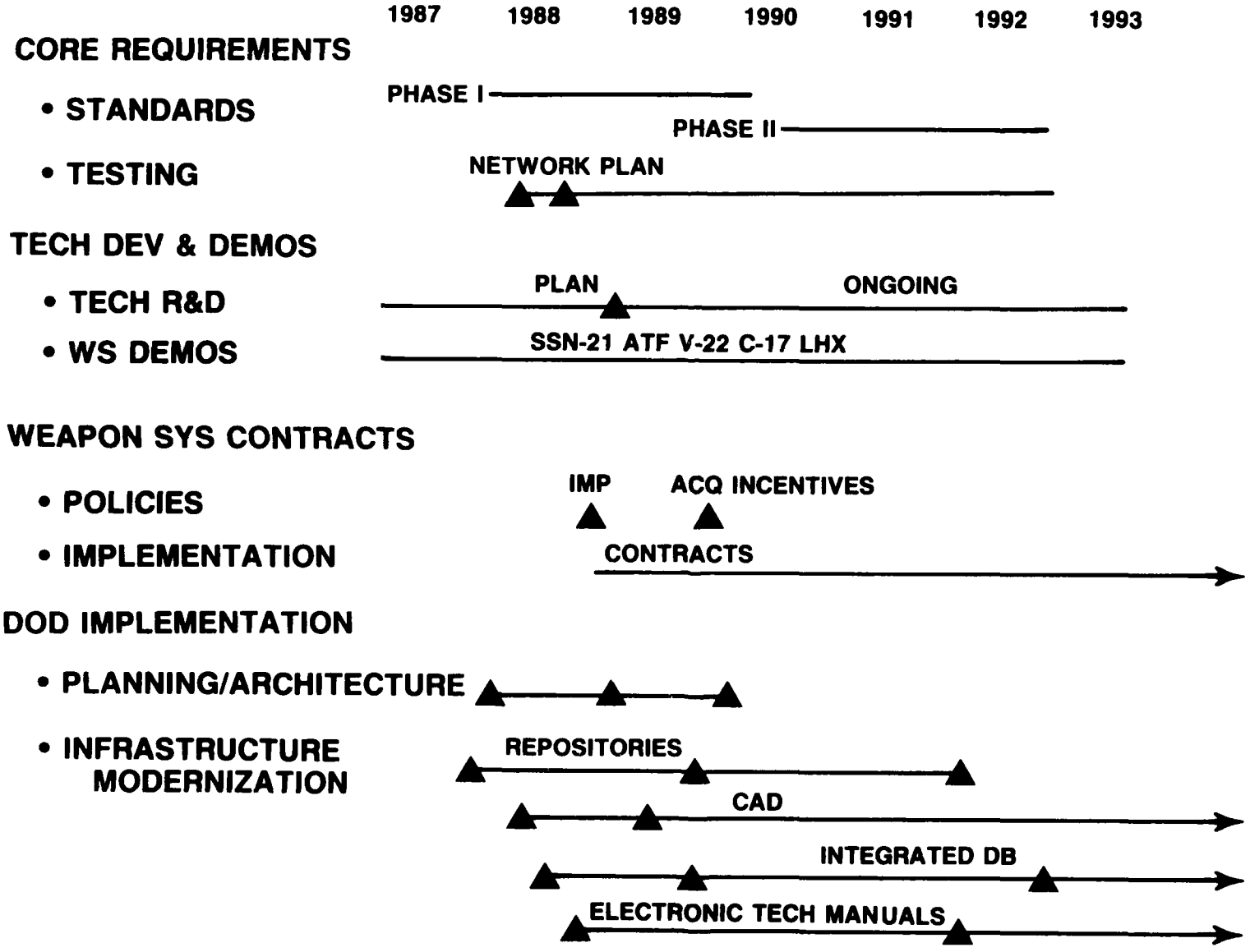
CALS SCHEDULE OBJECTIVES



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DOD FUNDING FOR CALS

Direct investment	FY87	FY88	FY89
OSD	13.6M	13.0M	13.0M
DOD	173.7M	223.8M	120.0M*

CALS funds leverage multi-billion dollar plans for modernization in DOD and industry

*Reduction due to removal of 3 large infrastructure programs from CALS oversight

CALS IMPLEMENTARY POLICY (DRAFT DEPSECDEF MEMO)

- Systems now in FSD or production
  - Review cost saving and quality opportunities from changing to digital delivery or access
- Systems entering development after Sep 1988
  - Require proposals for CALS data delivery or access
- Infrastructure systems
  - Program resources for systems to receive and use digital data
  - Configure or adapt systems to support CALS standards
- Acquisition policy
  - USD(A) will issue further guidance on contracting, incentives, subcontractors, funding mechanisms.

WEAPON SYSTEM CONTRACT - 1990s

- Emphasis of CALS in source selection criteria
- Movement toward functional requirements integration
  - Integration of R&M with CAE
  - Automated generation of logistics data products
  - Integrated CAE/CAM/CALS data base
- Movement toward paperless delivery of logistics data products
  - Product definition data
  - Technical manuals
  - LSA record data
  - Training materials
  - ILS management

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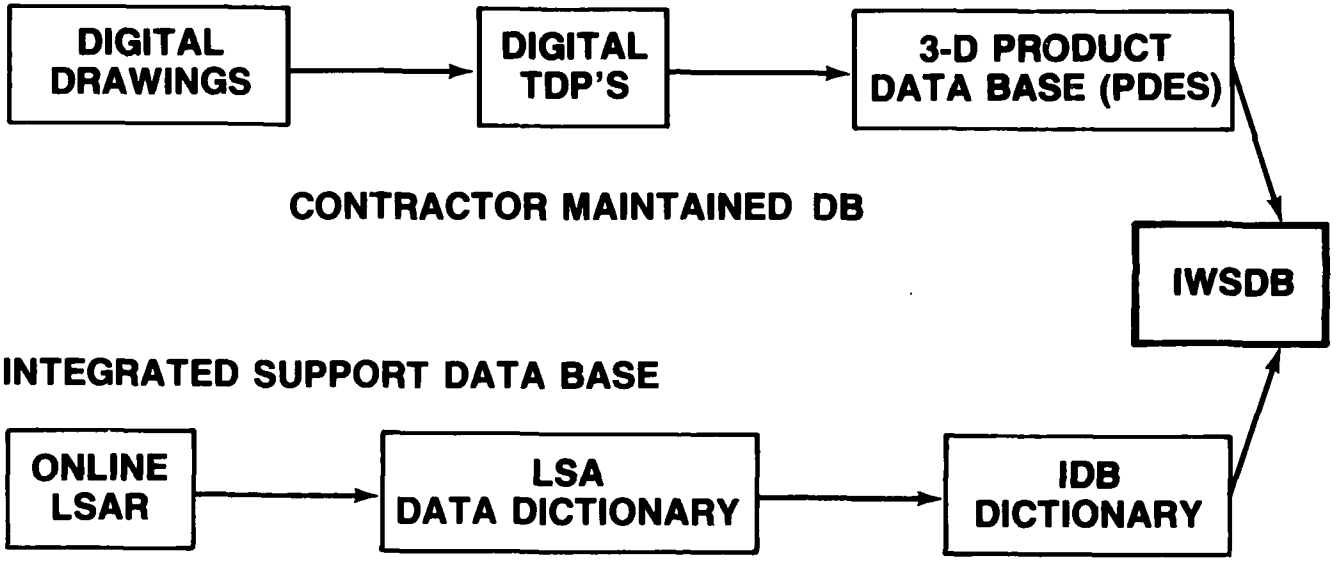
CALS: WHERE ARE WE GOING?

- PRODUCT DEFINITION DATA



- INTEGRATED SUPPORT DATA BASE

ON LINE REVIEW & APPROVALS, PROVISIONING, ORDERING

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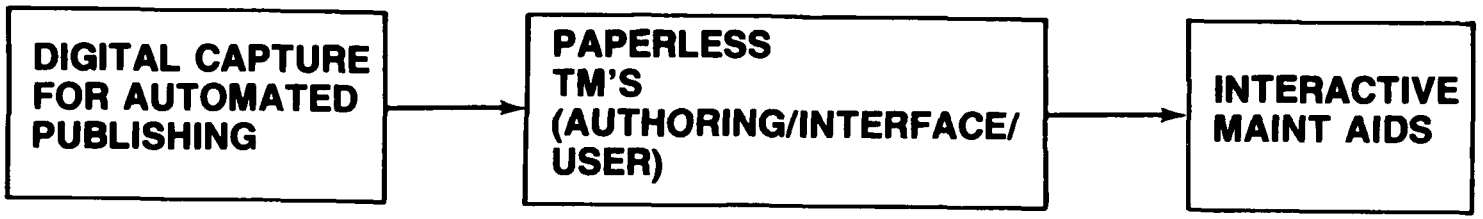
CALS: WHERE ARE WE GOING?

APPLICATIONS

- **TECHNICAL MANUALS**



ELECTRONIC PRESENTATION OF EXPERT SYSTEM TROUBLESHOOTING ROUTINES

- **SPARES ACQUISITION**
- **TRAINING MATERIALS**
- **OTHERS**

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IMPLEMENTATION POLICY

Important considerations

- Recognize that integration is not an "all or nothing" proposition
  - See how far bidders can go
- Online access will be limited to selected contractor data bases
  - Principal targets are deliverables for review and approval
- Routine delivery of digital data will be paced by availability of validated standards and government receiving systems
  - Define requirements now for data to be delivered in the 1990's
  - Seek flexible alternatives to hedge risks

Bottom line

- Keep CALS target in sight, but do what makes sense for each program
- CALS lead programs are good examples

WEAPON PROGRAM IMPLEMENTATION EXAMPLES

PROGRAM	ACQUISITION PHASE	# OF CONTRACTORS OR CONTRACTING TEAMS	RFP REQUESTS	DELIVERY DATE
ATF	ADVANCED DEVELOPMENT	2	DEFINE DIGITAL DELIVERY MODES	1989
LHX	ADVANCED DEVELOPMENT	2	DEFINE DIGITAL DELIVERY FOR TECH MANUALS AND LOGISTIC DATA	1990
JVX	FULL-SCALE DEVELOPMENT	2	REVIEW AF AND NAVY PROGRAMS AND DEFINE APPROACH R&M LINK TO CAE/CAD	(1988)
SSN-21	FULL-SCALE DEVELOPMENT	2	IMPLEMENT DIGITAL DELIVERY	1988-1990

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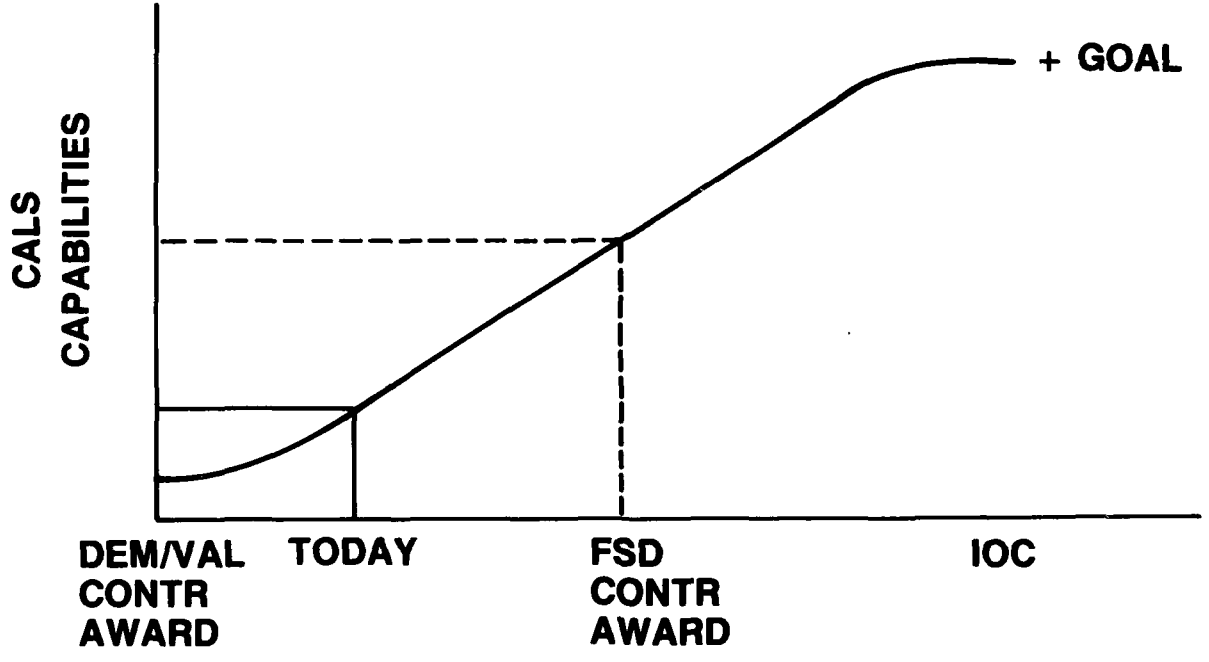
V-22 CALS DEMONSTRATIONS

Title	Description	Expected Completion date
CAD	Interchange data between Bell/Boeing	Sep 87
LSA/LSAR	Automated database - three contractor interchange - government access	Oct 87
Provisioning	Automated H Sheet delivery on line access (ASO pilot)	Oct 87
SML	On line access - interfaced to LSAR	Oct 87
Publications	Prompted authoring - link to LSAR	May 88
Task and Skill Analysis	Automated link to LSAR - G Sheet access on line (MIL-STD 1379)	Feb 88
Training Courseware	Prompted authoring - link to LSAR and pubs	May 88
SERDS	Tri-service format - link to LSAR on line access	May 87
LORA	Link to LSAR on line access	Jan 88
Engine Monitoring System	Diagnostics and health reporting	Sep 88
Operational Feedback	Operational feedback data to improve engineering and logistics design	Sep 89

ATF CALS DIRECTION

- SIGNIFICANT CALS CAPABILITIES EXIST
- MAJOR ADVANCES BEING MADE
- CLEAR INDUSTRY LEADER BY IOC
- COORDINATION WITH USAF TO ENSURE MATCHING CAPABILITIES



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ATF FUNCTIONS SUPPORTED IN CALS ENVIRONMENT

- Concurrent design
- Design change control
- Design influence
- Data management
- Manufacturing
- Cost account management
- Quality assurance
- Customer interface
- Subcontract management
- Data management
- Lessons learned data base
- Supportability design-to reqmts
- Logistics support analysis
- Support equipment
- Training analysis
- Technical orders
- Provisioning order/processing
- Manpower & personnel
- Reprocurement data
- Facilities requirements
- Failure/feedback/corrective action

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CALS APPLICATIONS - COMPUTER MOCKUP(COMOK)

- Simulation of maintainability and supportability functions prior to design release - support equipment requirements addressed early in design
- Safety considered in simulations of weapons separation, take-offs, and landings
- Cockpit ergonomics and human factors considerations
- Design input to the Logistics Support Analysis Record (LSAR)
- Interface to IGES/PDES neutral files

COMPUTER MOCK-UP EXAMPLE

METAL MOCK-UP	VS.	COMPUTER MOCK-UP
SEQUENTIAL DESIGN		PARALLEL DESIGN
SUPPORTABILITY REQUIREMENTS NOT FULLY ADDRESSED UNTIL AFTER AIRCRAFT DESIGN		SUPPORTABILITY REQUIREMENTS ADDRESSED EARLY IN DESIGN PROCESS THROUGH ZONE COORDINATION MEETINGS
METAL MOCK-UP FABRICATED AFTER DESIGN IS COMPLETED		COMPUTER MOCK-UP IS USED FOR CONCEPTUAL AND DETAIL DESIGN STUDIES AS IT EVOLVES ITERATIVELY AS PART OF THE DESIGN PROCESS
DESIGN DATA IS RE-ENTERED MANUALLY TO CREATE ANALYSIS AND MANUFACTURING MODELS		COMOK PROVIDES CENTRAL DESIGN DATABASE FOR AUTOMATED TRANSFER OF DESIGN DATA TO DOWNSTREAM ANALYSIS AND MANUFACTURING FUNCTIONS
RETROFIT DESIGN CHANGES UNCERTAIN - NO ENGINEERING DATA EXISTS FOR PRECISE TUBE/ WIRE HARNESS ROUTES THROUGH AIRCRAFT		QUALITY OF RETROFIT CHANGES IMPROVED—PRECISE ENGINEERING DATA EXISTS FOR TUBE/WIRE HARNESS ROUTES

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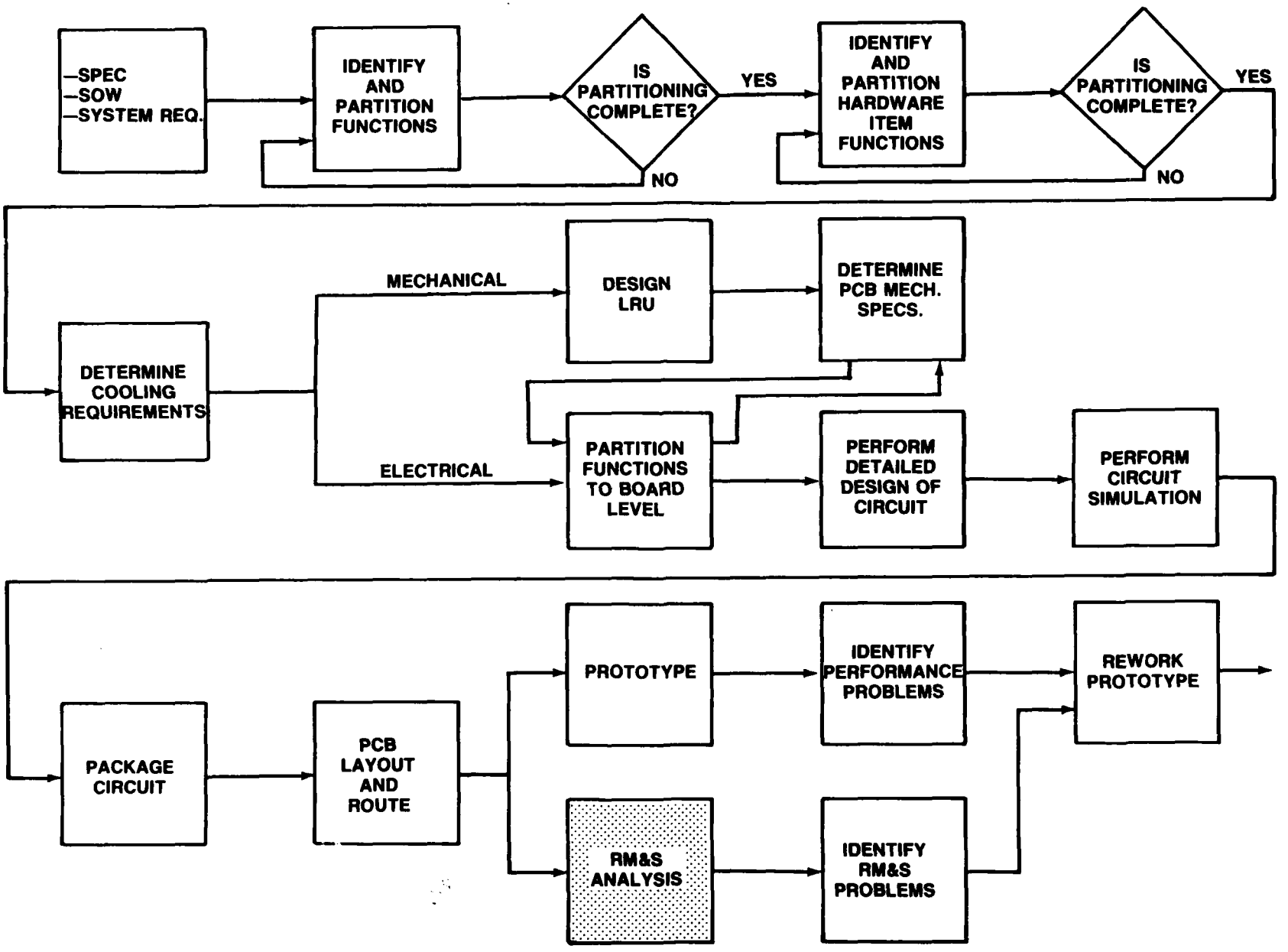
R&M - CURRENT AVIONIC DESIGN PROCESS FLOW



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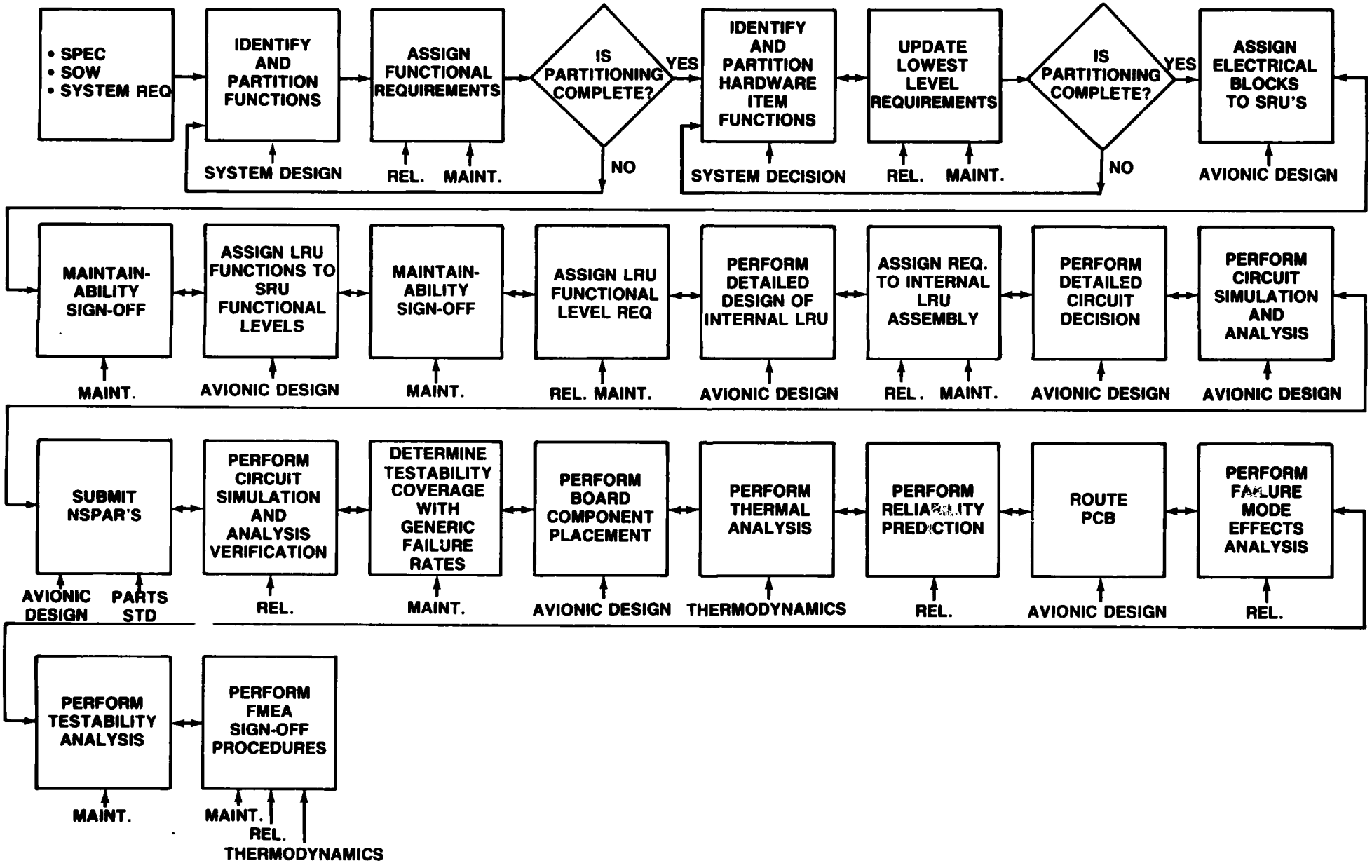
FUTURE RM&S/ELECTRONIC DESIGN CAE SYSTEM PROCESS WITH DESIGN SYNTHESIS



ATF CALS DEMONSTRATIONS

AREA	MH	$	CYCLE TIME
Training development process	30%		
PPL process			6 months to 2 hours
Engineering release for spares order release			190 to 85 days
Paperless order processing	50%	80%	
On-line SERDS			90 to 70 days
On-line CFENS			91 to 69 days

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ATF CALS DEMONSTRATION

AREA	% AUTOMATION	CONNECTIVITY
Job planning/scheduling	0 to 50%	None to high
Basic design process	0 to 85%	None to high
Partnership design interface	25% to 80%	None to high

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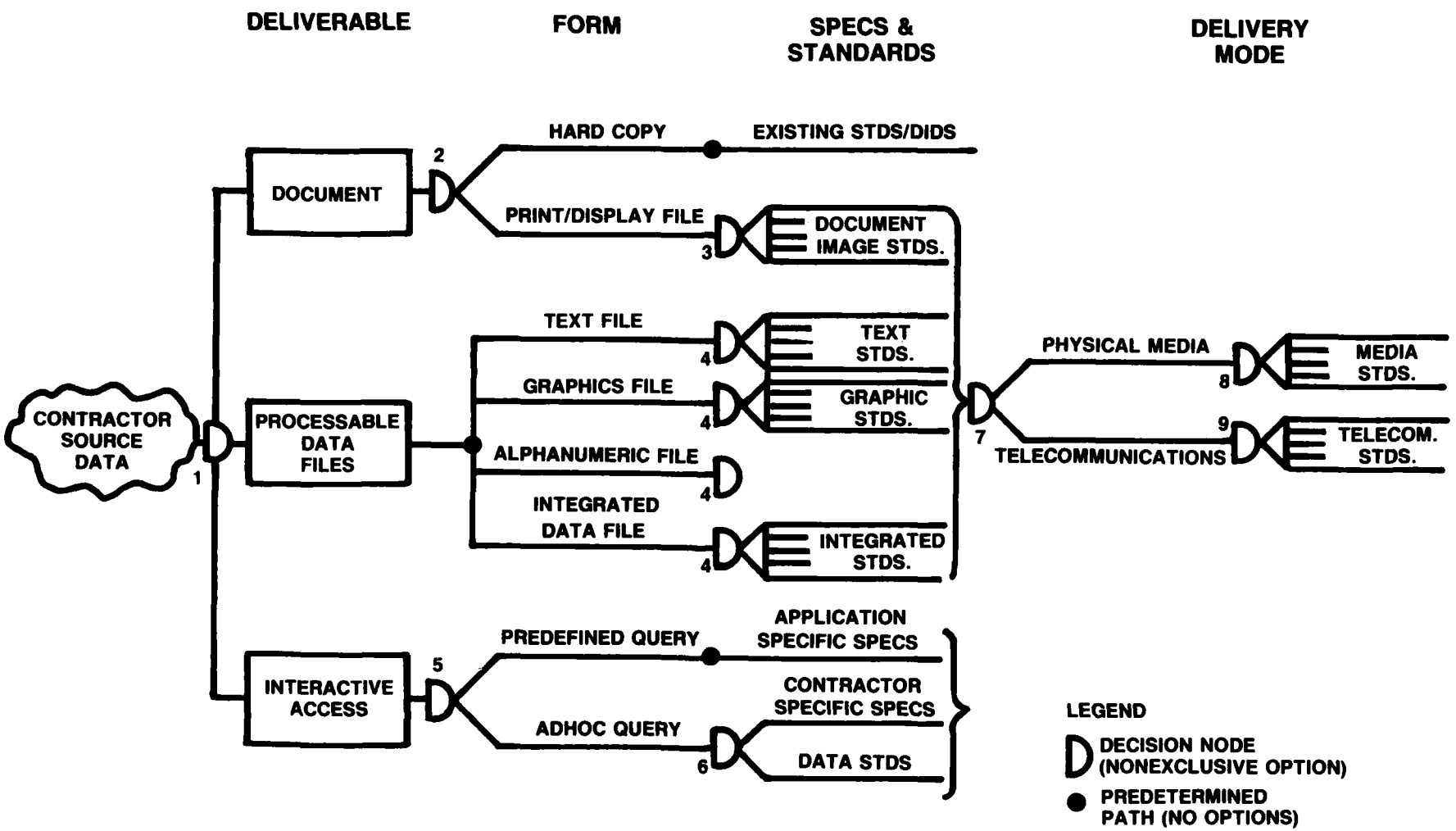
CALS IMPLEMENTATION GUIDE

- Guidance for digital deliverables
  - Decision trees, criteria, examples
- Functional requirements
  Model SOW and tailored MIL-STD language
- Initial coverage (Apr 88)
  - Engineering drawings
  - Technical manuals
  - Online LSAR
  - Security
  - R&M integration with CAD/CAE

DECISION TEMPLATE FOR ACQUISITION OF DIGITAL DELIVERABLES



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DATA USE CATEGORIES

CATEGORY	EXAMPLE OF USE
Archive	Retain R&M predictions for later comparison
View	Review contractor data
Annotate/excerpt	Review/comment on contractor data
Update/maintain	Update GFE portion of assy drawings and associated parts lists
Process/transform	CAD into CAM; TM material into specific maintenance aids.

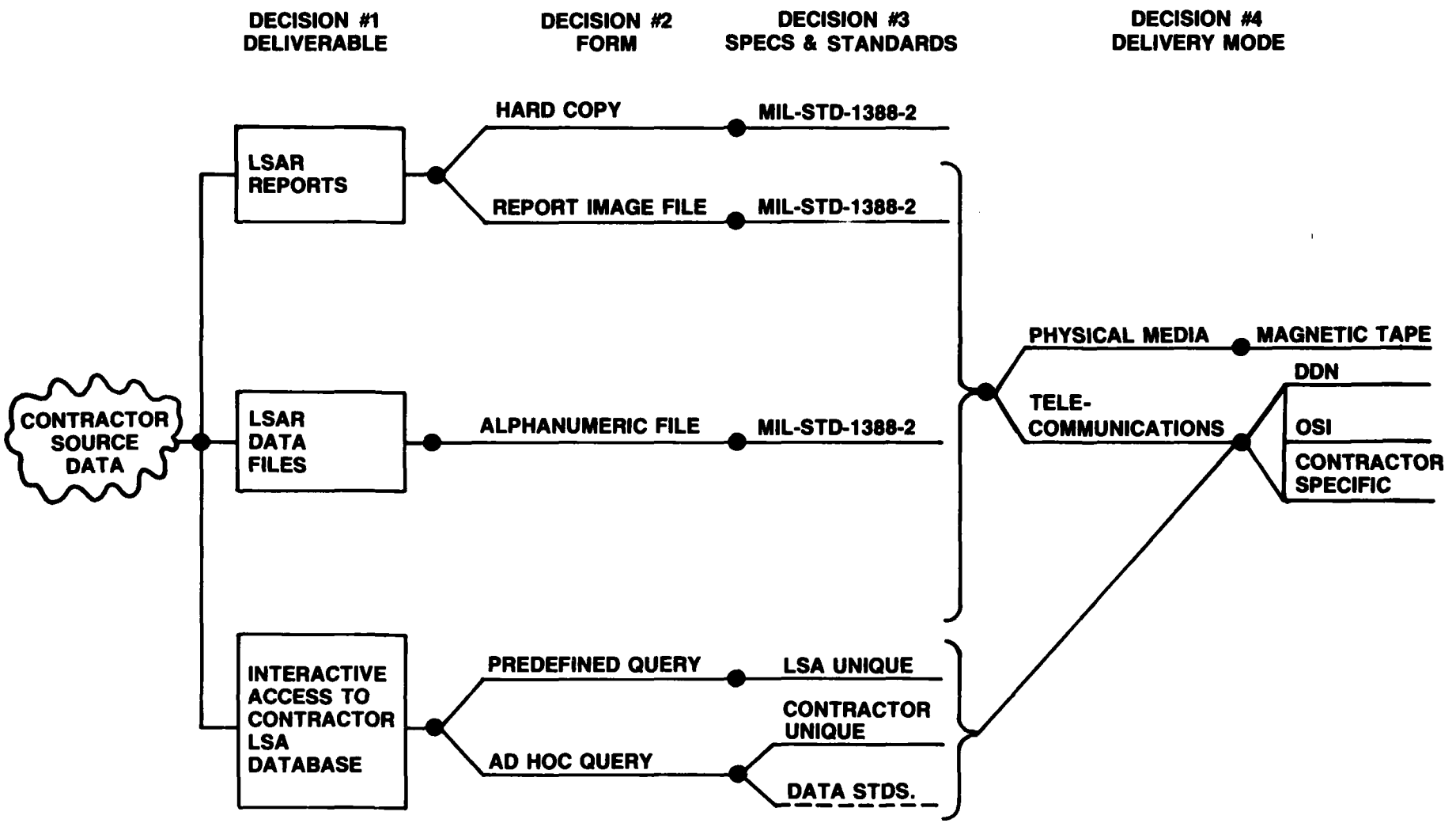
POSSIBLE CALS RFP CONTENT - GENERAL

- CALS plan
- Supplier/vendor/subcontractors
- GFI
- Data rights and control
- Security, data rights/related issues
- Delivery modes

CALS LSAR OVERVIEW

- LSAR exists now and generally satisfies:
  - Maintenance plans
  - Provisioning data
  - SERDS
  - Calibration measurement
  - PHST
  - Input to TM and training
- LSAR will be baseline for CALS data elements dictionary
- Contractor designed LSAR data systems
- Use of LSAR and output reports vary by phase
- Internal contractor as well as DOD use

DECISION TEMPLATE FOR LOGISTIC SUPPORT ANALYSIS RECORD (LSAR)



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INTENDED USE - LSAR

- Data files
  - For consolidation of deliverables
  - If internal analysis planned
  - For report to automated govt support systems

- Interactive access
  - Predefined queries for LSAR review
  - Ad hoc queries to support unique needs

LIFE CYCLE PHASES - LSAR

- Hard copy
  - Early phase, low volume data
  - Nondevelopmental programs with limited service life
- Data files
  - Later, high volume requirements
- Interactive access
  - Replace early phase LSAR deliverables
  - Support LSAR data reviews

DELIVERY COST - LSAR

- Report image files of multiple report copies required
- Data files, in general
- Interactive access to minimize on-site review
- Magnetic tape for high volume

AVAILABLE TECHNOLOGY - LSAR

- Hard copy or interactive access if no govt capability
- Image file or interactive access if govt capability limited
- Data files for FSD or production if govt has internal capability

LSAR DELIVERABLES - SOW CHANGE

Deliverable and Form	Delivery Mode	Implement With
1. LSAR Report Files	Magnetic Tape	New SOW1
2. LSAR Report Files	Telecommunications	New SOWs 1 & 2
3. LSAR Master & Data Files	Magnetic Tape	New SOW1
4. LSAR Master & Data Files	Telecommunications	New SOWs 1 & 2
5. Interactive Predefined Query	Telecommunications	New SOWs 1 & 2
6. Interactive Ad Hoc Query	Telecommunications	New SOWs 1 - 3

R&M INTEGRATION WITH CAD/CAE - GENERAL BACKGROUND

R&M effectiveness

R&M and LCC

Current R&M and the design process

New approach

ACHIEVING THE POTENTIAL OF CAE AND R&M

Improvements needed

- Automated R&M analysis tied to parts libraries and materials characteristics data bases
- Automated R&M synthesis based on design rules and incorporating lessons learned
- Linkage of CAE SW and data bases and R&M impact on design decisions
- Supporting HW, SW, and computer networks to support the above

Ultimate goal

- Concurrent or near concurrent integration of R&M impact and design decisions

SUGGESTED R&M - CAE RFP AND SOURCE SELECTION PROCESS

Two step process

- RFP - Section L (instruction and conditions)
  - Identify capability and experience
  - Explain extent of R&M/CAE integration
  - Describe use of R&M/CAE to satisfy RFP
- RFP - Section M (evaluation factors for award)
- Use of responses in final negotiations

Tailoring

- CDRLS/DIDS
- Development phase
- Frequency of submission vs on-line access

Sample language for Section L, M, CDRLS, DIDS

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DELIVERY MODES AND SECURITY

Delivery modes for physical media

Delivery modes for telecommunications

Security

- Government issues
- Industry issues
- Telecommunications
- Computer security needs

IDENTIFICATION OF SECURITY BY DATA ITEM

SECURITY LEVELS OR CONCERNS

DOD REQUIREMENTS

TOP SECRET
CONFIDENTIAL
FOR OFFICIAL USE ONLY (FOUO)
MOSAIC
EXPORT CONTROL

INDUSTRY REQUIREMENTS

COMPETITION SENSITIVE
COPYRIGHTED
TECHNOLOGICALLY SENSITIVE
COST SENSITIVE
(MOSAIC (APPLIES TO INDUSTRY AS WELL AS DOD DATA)

LEVELS OF SECURITY CONTROL

SYSTEM LEVEL CURRENTLY FOR CLASSIFIED INFORMATION
TRANSACTION LEVEL CURRENTLY FOR SENSITIVE UNCLASSIFIED DATA
DATA ELEMENT LEVEL IN FUTURE CALS SYSTEMS

USER PROFILES

ACCESS AND CONTROL (FOR EXAMPLE)
- BY DOMESTIC COMPANY
- BY FOREIGN COMPANY
- BY DEPARTMENT
- BY PROJECT
- BY GROUP

PROCEDURES AND SOFTWARE RULES FOR ACCESS AND CONTROL USER PROFILES, WHICH BECOMES A MATRIX MATCHING THE DATA SECURITY LEVEL WITH THE USER PROFILE.

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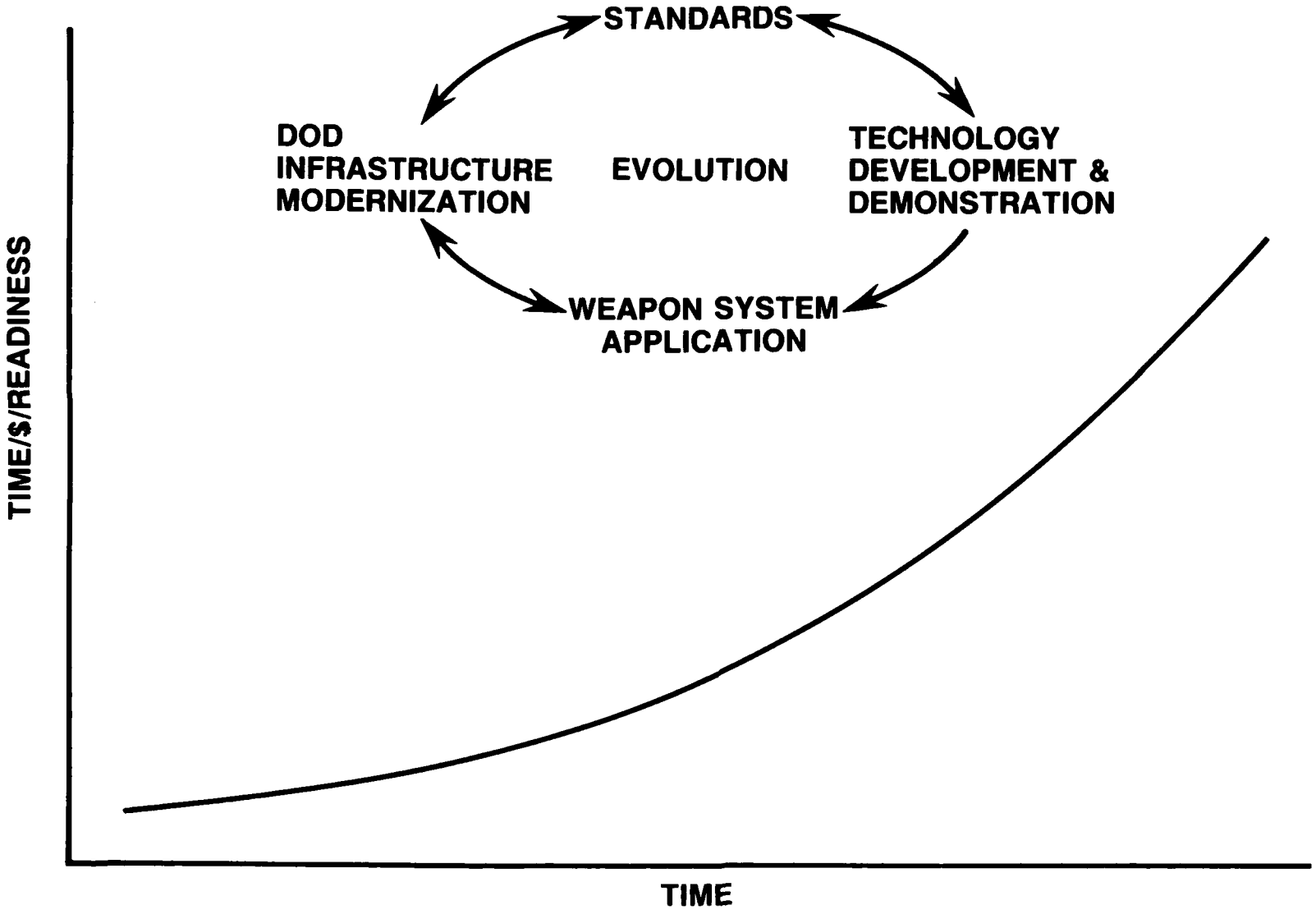
GROWTH IN PROGRAM BENEFITS



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TECHNICAL ASPECTS

- Standards
- Technology and demonstration projects
- CALS architecture and infrastructure implementation
- Testing

INITIAL CALS STANDARDS

- MIL-STD-1840A, "Automated Interchange of Technical Information," Dec 1987
- MIL-D-28000, "Digital Representation for for Communications of Product Data: IGES Application Subsets," Dec 1987
- MIL-M-28001, "Markup Requirements and Generic Style Specification for Electronic Printed Output and Exchange of Text,", Feb 1988
- MIL-D-CGM, "Digital Representation for Communication of Illustration Data: CGM Application Profile," now in coordination.
- MIL-R-RASTER, "Requirements for Raster Graphics Representation in Binary Format," now in coordination.

STANDARDS IN DEVELOPMENT

- Office Document Architecture and Interchange Format (ODA/ODIF)
- Standard Page Description Language (SPDL)
- Information Resource Dictionary Systems (IRDS)
- Structured Query Language (SQL)
- Production Data Exchange Specification (PDES)

TECHNOLOGY DEVELOPMENT AND DEMONSTRATION PROJECTS

AREA	87	88	89	90	91	92
ADVANCED PRODUCT DATA TECHNOLOGY		ISS (AF) GMAP (AF) IDS (AF) MCM (N)		DGIS (DLA) EIS (AF) MEP (AF)	RAMP (N)	
ELECTRONIC TM/TOS AND TRAINING MATERIALS	NTIPS (N)	MEIDS (N)		SMDP (DLA) AIM (N) ITDS (AF) CATIS (N)	CBAT (N)	IMIS (AF)
INTEGRATION OF SUPPORTABILITY WITH DESIGN	MLCAD (AF)	GBD (AF)		IDSS (N)		
PARTS DATA ACCESS		GFB (DLA)		MIDS (A)		

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CALS ARCHITECTURE AND INFRASTRUCTURE IMPLEMENTATION

AREA	87	88	89	90	91	92	93
ARCHITECTURE PLANNING	MI0/ATI (AF) NSTIS (N)					LSMP (DLA)	ACALS (A)
ENGINEERING DATA REPOSITORIES AND PRODUCT DATA	DSREDS/EDCARS (A/AF) MEDALS (DLA) TD/CMS (A) MPCASS (DLA)		EDMICS (N/DLA)		CAD-2 (N)		
AUTOMATED PUBLISHING AND PAPERLESS TM SYSTEMS	AFTOMS/ ATOS (AF) IIS (AF)		NAPS (N) NPODS (N)				

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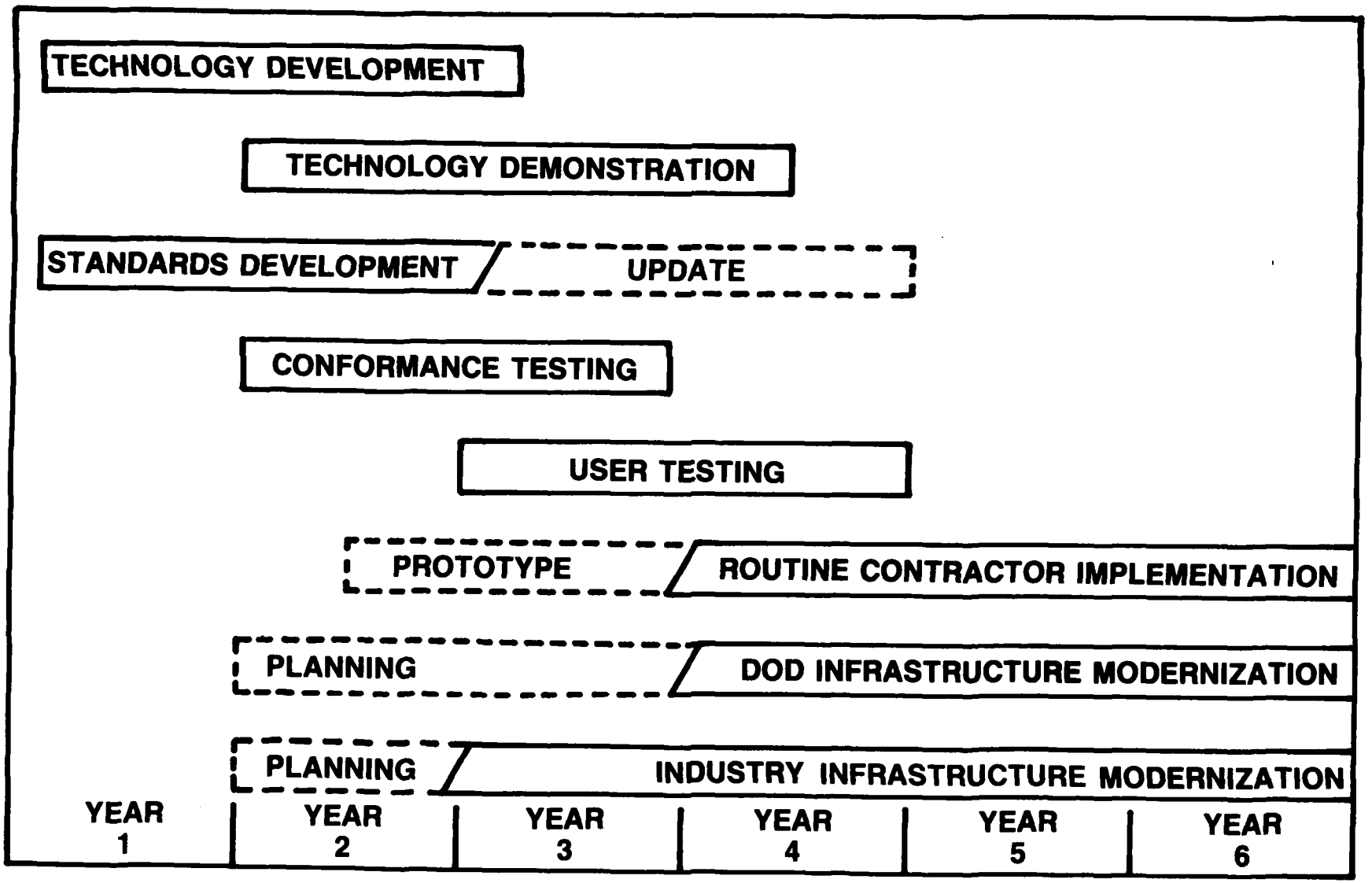
CALS STANDARDS IMPLEMENTATION STEPS



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CALS IMPLEMENTATION ISSUES

- Rights to data
- Security, privacy, export controls
- Profit structure, investment incentives
- Delivery, verification, acceptance
- Legal liability
- Co-operative production (other nations)
- DAR, FAR revisions
- ADP acquisition process

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CALS BENEFITS

From industry's perspective

- Productivity gains through automation and integration
  - Less effort in design/manufacturing transition
  - Less redundancy in data preparation
  - Paperless interchange among primes, subs
- Quality improvements
  - Product design
  - Data
- From government's perspective
  - Productivity gains
    - Acquisition
    - Operation
  - Improved readiness
  - Shortened lead times
  - Timely, accurate, accessible data

SUMMARY

- DOD is committed to achieving major gains through automation
- The CALS recommended strategy will be implemented
- Will require concerted planning and investment by both DOD and industry

DRAFT

NARRATIVE FOR DSMC MALC COURSE CALS MODULE

11 October 1988

VUGRAPH 1 - COVER

This presentation covers the status of the Computer-aided Acquisition and Logistic Support (CALS) Program. CALS is an effort to reduce paper - and get out of the manual mode of data generation.

CALS is a high priority initiative within the Department of Defense (DOD). It was started in 1985 based on recommendations from a high level joint DOD and industry task force. CALS will have a heavy impact on other DoD program management, the DoD logistics infrastructure, and the commercial as well as the defense segment of industry.

CALS will increase productivity in DoD and industry - but the bottom line for DoD is really improved readiness and tools in the hands of the GI.

CALS is a classic example of a management strategy to:

(1) achieve synergism

(2) combine parts such that the sum of the whole if greater than the sum of the individual parts, or

(3) kill more than one bird with one stone.

(4) leverage

Much of the material we will cover is contained in your handout material.

VUGRAPH 2 - WEAPON SYSTEM AND EQUIPMENT APPLICATION POLICY

The CALS program is about to impact heavily on Defense major system program management as shown by this excerpt from a memo recently signed by Deputy Secretary of Defense Taft. A copy of this memo is in your handouts. The policy essentially says that OSD will not force backfitting on programs now in FSD or production, but CALS will be applied to all other major weapon system developments after September 1, 1988. The services will apply their own judgment on application to less than major systems.

VUGRAPH 3 - OUTLINE

This chart shows the general outline this presentation will follow. We will basically address the what, why, where, how, and when of CALS, then briefly review it's implementation on major systems and equipments, discuss the technical aspects of CALS and cover some issues.

VUGRAPH 4 - WHAT IS CALS?

Widespread use of computer-aided design and engineering (CAD/CAE) has created a new environment where product description data is becoming available in digital form to support a wide range of DoD and Industry applications. CALS is a DoD and Industry initiative to enable and accelerate the use and integration of this digital technical information for weapon system acquisition, design, manufacture, and support. The initial inpetus for CALS came from industry leaders frustrated by the inability of various automated systems to communicate. Through management of the CALS program, a comprehensive strategy has been developed to transition from the current paper-intensive mode of operations to a highly automated and integrated mode, thereby substantially improving productivity and quality. Implementation of CALS has begun, and is already leading to a major impact on the way DoD and Industry conduct business.

OBJECTIVES AND BENEFITS

The Deputy Secretary of Defense initiated the DoD CALS program in September 1985, with the goal that new weapon systems would either acquire technical data in digital form in lieu of paper deliverables or obtain government access to contractor integrated data bases by 1990. Substantial quality improvements and cost reductions are expected, including:

- Reduced acquisition and support costs for weapon systems programs through elimination of duplicative, manual, error-prone processes.

- Increased quality and timeliness of technical information for support planning, procurement, training, and maintenance, as well as improved reliability and maintainability of weapon system designs through direct coupling to CAD/CAE design processes and data bases.

VUGRAPH 4 - WHAT IS CALS? (Continued)

- o Improved responsiveness of the industrial base by development of integrated design and manufacturing capabilities and by Industry networking to build and support weapon systems based on digital product descriptions.

Here in a nutshell is what we are trying to do. CALS is an integration program. We want to transition to a near paperless environment for design, manufacturing, and support of weapon systems, thereby gaining the productivity and quality benefits that will come from a highly automated and integrated mode of operation. Today's environment consists of stand-alone functional application areas, both in industry and DoD. To some extent those functional applications have been automated over the past 10 years with the result that we have islands of automation that cannot easily communicate with one another. That is true both within and between prime contractor's plants as well as between DoD and Industry. The flow of information today is primarily in hard copy form.

EXAMPLES OF ISLANDS OF AUTOMATION

The CALS 1987 Report to Congress cited some 52 different major logistics related automation projects within DoD in the areas of data repositories, printing and publishing systems, authoring systems, data base management and information processing systems, communication access and data distribution, presentation and maintenance aids, automated procurement and parts control systems, CAD/CAM and related tools, and system integration and architecture.

TOO MUCH PAPER

The DoD logistics system is currently hindered by immense amounts of paper. To illustrate this fact, DoD has some 200 million drawings - with each at best on an 80 column aperture card.

VUGRAPH 4 - WHAT IS CALS? (Continued)

Another example is the current manually oriented Air Force Tech Order system. It currently has over 150,000 active Tech Orders (TOs) which range between 100-150 pages each, with 60 percent text and 40 percent graphics.

This is a total of about 20 million pages. Each year about 2-3 million pages are revised. The current backlog is estimated to be as much as 2 million pages.

Deficiencies or problems in the current system include:

- Up to 500 days to fully implement a routine change.
- Cost of roughly $1,000 per page (expected to increase to $2,000).
- From 1977 to 1986, 47 percent of Cause Code 1 mishaps listed inaccurate TOs as a contributing factor with resulting equipment losses of about $86 million.
- A single system, such as the B-1B, generates 35,000 new TOs, adding a million pages to the TO data bases.

This is not picking on the Air Force. The other services have similar problems. The Air Force has a major CALS initiative underway in this area.

VUGRAPH 5 - WHAT IS CALS - CHANGE OVER TIME

To achieve CALS benefits, a phased strategy has been planned by a team composed of Office of the Secretary of Defense, the DoD Components, and Industry. Phase I will replace paper document transfers with digital file exchanges and begin process integration, and will be implemented between now and the early 1990s. In parallel, technology is being developed for Phase II, which involves substantial redesign changes in current processes to take advantage of a shared data base environment in the early 1990s and beyond. The main roles of DoD in both phases are: (1) to accelerate the development and test of data interchange and access standards, (2) to fund demonstrations and technology development in high-risk areas, (3) to encourage Industry investment in integrated processes by establishing contract requirements and incentives and (4) to implement CALS capabilities in DoD's own extensive automated systems.

The vugraph illustrates the islands of automation and paper flow today, the digital flow which is the objective of the first phase of CALS, and the ultimate shared data base which is the ultimate objective. This shared data base, called the integrated weapon system data base, will feature standard interfaces between design, design analysis, manufacturing process planning, and the support data base previously mentioned. A key element is the development and implementation of neutral data interchange standards which will make us hardware independent and allow the present islands of autonomy to be linked together to permit automated, rather than manual, transfer of data. The CALS initiative will permit DoD to present one interface to industry. This is essential in view of the sizable investments required. The ultimate integrated data base will have both product and support data. We are already well on the way to an integrated support data base since it will be an outgrowth of the current LSA Data Base. Incidentally we are not talking one massive data base. The emphasis is on connectivity of many data bases.

VUGRAPH 6 - SCOPE

Automation and digitization is being applied to many functional areas, this vugraph shows the major areas which CALS will address.

CALS encompasses the generation, access, management, maintenance, and distribution of technical data in digital form for the acquisition, design, manufacture, and support processes. Within CALS, the common thread is technical data which includes engineering drawings, product definition and logistic support analysis data, technical manuals (TMs), training materials, technical plans, reports and operational feedback data associated with weapon systems, equipment and ships. Each of the above four segments of the CALS strategy cited relate to technical data in one or more processes. Since the logistics support analysis data can provide maintenance plans; provisioning data; support equipment requirements documents; calibration measurement recommendation data; and packaging, handling, and storage, and transportation data and feed into TMs and training materials, CALS will essentially encompass the ILS elements.

A third major area of CALS focus is on the integration of CAD/CAE/CAM/CALS process, particularly from an R&M and support-ability viewpoint. This will enable earlier R, M and S influence on design. Since R&M is frequently responsible for as much as 30 percent of life Cycle Cost (LCC), CALS will help achieve our long desired goal of greater R, M and S design influence, which benefits in lower LCC and/or improved readiness.

VUGRAPH 7 - BENEFITS SUMMARY

Can CALS reduce our dependency on paper and improve readiness and reduce life cycle costs and development time? Numerous studies and examples indicate the answer is yes. This chart illustrates some of the projected benefits predicted by experts in various studies to date.

VUGRAPH 8 - BENEFITS - ILS

This chart shows the projected savings in labor and time for ILS management and some of the ILS elements for a typical aerospace weapon system for the first seven years of program life. The time saving should contribute to improved initial operational readiness.

VUGRAPH 9 - BENEFITS - F-16

This vugraph shows a more specific example of potential savings in storage and distribution costs of technical orders for the AF F-16. Over the next five years, as the sales of optical discs and disc players increase, costs will decrease at a marked rate. The chart compares costs for four major storage and distribution methods: paper, removable cartridges, Computer Disc-Read Only Memory (CD-ROM) and Write Once-Read Many Times (WORM) optical discs.

As optical disc technology matures, the number of optical discs required to store a suite of Tech Orders for the F-16 will diminish from twelve optical discs to three optical discs and the unit cost per disc will further decrease from approximately $400 to $100. The combination of these two factors will reduce costs by a factor of 10, that is to about $492 by 1995.

This example also illustrates that potential CALS benefits depend on the pace of technology development. We will talk more about this later.

VUGRAPH 10 - RAMP

This chart is another example of possible infrastructure benefits. RAMP stands for Rapid Acquisition of Manufactured Parts. RAMP is an ongoing Navy project at the NBS to develop and demonstrate computer integrated manufacturing technology to produce low volume spare parts on demand. The technologies involved include adaptive process control software, robotics, and electronic parts technical data interchange.

The chart shows the possible reduction in overall procurement time using RAMP and other CALS technology. Lead times currently can run to over a year. Unit cost reductions of 30 percent and a reduction of 50 percent in production facilities are other potential benefits.

RAMP is also a possible solution to the problem of disappearing manufacturing sources, a major problem in post production support.

VUGRAPH 11 - TIME SAVING CONCURRENCY

Our last benefits chart again illustrates time-reduction possibilities as CALS technology is implemented over time.

The integration of R&M with design is a major CALS initiative which depends on interfacing automated tools with both product data and operational feedback data to affect new design. A joint DoD/Industry work group has evaluated technical and management approaches to this problem, and published recommendations for DoD implementation. The key objectives are a subset of the larger concern for designing quality into new products. Coordination of R&D projects is being accomplished through a joint DoD/Industry study of "Concurrent Engineering" sponsored by OSD and hosted by the Institute for Defense Analyses. Recommendations are due by December 1988.

VUGRAPH 12 - CALS STRATEGY

I said to achieve CALS benefits, a two phased CALS strategy has been established. The main segments in both phases are:

- o Standards. Accelerate the development and testing of standards for digital technical data interchange and integrated data base access,

- o Technology Development and Demonstration. Sponsor technology development and demonstrations in high-risk areas for integration of technical data and processes,

- o Weapon System Contracts and Incentives. Implement CALS standards in weapon system contracts and encourage Industry modernization and integration,

- o DoD Systems. Implement CALS standards and integration requirements in DoD planning and infrastructure modernization programs.

Progress in each area will synergistically foster progress in the other areas, with the technology development and demonstration and the standards driving progress. This approach will enable DoD to present a unified DoD interface to industry, and should result in lower front end costs in implementation both in industry and within the DoD infrastructure.

VUGRAPH 13 - PHASED IMPLEMENTATION

This chart highlights key areas of interest in each phase of CALS implementation.

The first stage of transition in CALS is to convert that paper flow to a flow of digital files (a digital field exchange). At the same time we will begin to integrate the islands of automation within industry and within DoD, and thereby eliminate some of the redundant duplicative steps that are built into our current processes. Today we tend to buy the same piece of information many times over, i.e., create it, repeatedly store it in many different locations, and the result, in addition to added expense, is problems in the quality of data. Getting rid of paper is relatively easy to do. The interchange of technical data without resorting to paper products will result in increased accuracy and timeliness of data transfer at reduced costs.

Longer term objectives of CALS are (1) to obtain better product data and (2) get a shared data base environment where we open up the path for authorized government access to industry technical data bases and replace many of today's contract deliverable data products with on-line access.

The technology for Phase II of CALS is in an R&D stage at present, so we are bringing Phase II along in parallel with implementation of Phase I. Improved product data means improved digital reprocurement data packages in the form of 3-D product models. This will have a host of benefits. Other expected benefits from Phase II include:

a. More complete integration than is possible in Phase I of contractor design, manufacturing, and support data systems based on advanced product data models

b. Near real-time updates of technical data to match weapon system configuration

VUGRAPH 13 - PHASED IMPLEMENTATION (Continued)

c. On-line access by government users to distributed contractor and government data bases

d. Data bases owned by DoD, but possessed and maintained either by DoD or by contractors

e. Automated technical manual authoring and delivery

f. Automated interfaces of spares procurement with flexible manufacturing systems

g. Integration of R&M engineering as an on-line part of the CAD/CAE design process

VUGRAPH 14 - MANAGEMENT STRUCTURE

A effort of CALS magnitude obviously has numerous management interfaces.

The DoD CALS Steering Group serves as the corporate board of CALS program within DOD. It is chaired by the Assistant Deputy Assistant Secretary Defense (Systems) and composed of senior representatives from each of the Military Departments, Defense Logistics Agency, and key DoD participants within the Office of the Secretary of Defense. The group meets monthly. Working groups facilitate the coordination process. The National Bureaus of Standards has been supporting CALS with about $3M in effort annually.

The Industry Steering Group shown on the chart coordinates activities within the CALS Industry Task Force, which is hosted by the National Security Industrial Association (NSIA), and includes membership from the Aerospace Industries Association (AIA), the Electronic Industries Association ((EIA), the National Computer Graphics Association (NCGA), Society of Logistics Engineers (SOLE), Institute of Cost Analysis (ICA), the Shipbuilders Council of America (SCA), and others.

VUGRAPH 15 - INDUSTRY AS A PARTNER

Industry Involvement. Substantial Industry momentum and enthusiasm have been generated for CALS, and DoD-Industry cooperation has been exemplary. Industry advocates have used DoD's commitment to CALS to gain internal management backing for investments in automation and integration of diverse processes. A voluntary CALS Industry Work Force has attracted over 400 members who have been extremely active in developing and coordinating CALS standards, defining integration requirements and addressing acquisition issues. Last year this group expended some 75 man years in support of CALS. The Industry Working Group currently has active committees in the areas of design integration, security, digital information transfers, acquisition, education/public communications, and international.

There are a lot of reasons for industry's attitude. CALS has enormous significance to commercial industry as well as the defense industry. Commercial industry is also burdened with paper. A recent article stated that there are two full sized 6 drawer file cabinets for each worker in the commercial sector. Industry sees CALS as an essential step in the drive to stay competitive. Ultimately the commercial investment will be far greater than that of the defense industry which in turn will be far greater than the DoD investment.

Ultimately major defense contractors will have such interfaces with other primes, their subcontractors, and vendors. This will be feasible with the increased capabilities of personnel computers.

Most recently, Industry has formed an Industry funded cooperative to accelerate the development of the Product Data Exchange Specification (PDES) which is the heart of Phase II CALS. A Government PDES Users Group has been established under the DoD CALS Steering Group to interface with the cooperative. PDES will be a 3-D model description providing all needed information on product functional characteristics, topology, geometry, tolerance, form feature,

VUGRAPH 15 - INDUSTRY AS A PARTNER (Continued)

assembly, manufacturing processes, and quality control. PDES is a key to better and earlier breakout and to programs such as RAMP, RAPID Acquisition of Manufactured Parts, a Navy program. This capability will contribute significantly to the disappearing manufacturing source problem, which frequently occurs as the inventory life of weapon systems continues to increase to 20 and 40 years. For example the B-52s are older than any of the pilots. The users group has representation from DoD, National Aeronautics and Space Administration, Department of Energy, and Department of Commerce/National Bureau of Standards. The head of the group is from commercial industry. This illustrates industry's recognition of CALS potential.

In addition to the support being provided through the Industry Steering Group and Task Force, individual companies are now incorporating CALS into their internal system integration and modernization efforts.

VUGRAPH 16- MAJOR MILESTONES

This next vugraph is too busy to be read in detail by an audience of this size. An expanded version of this chart is in the report to Congress. The chart summarizes some of the key milestones in the four major areas of standards, technology development and demonstration, weapon system contracts and incentives, and the internal DoD Architecture and Infrastructure Modernization. Two key near term management actions are completion of the CALS Master Plan this fall, and the CALS Technology Plan late this year or early next year. We will cover each of these areas in more detail later.

VUGRAPH 17 - FUNDING

DoD and Industry are already making upgrades to their ADP and infrastructure capability. By leveraging these investments, CALS offers an unprecedented opportunity to influence both DoD and Industry business processes for the next five to fifteen years.

This table shows the actual and projected CALS funding established in FY 87/88. These numbers have changed in FY89 since 3 large infrastructure projects have been removed from CALS oversight.

The DoD budget for CALS in fiscal year 1989 now totals $120 million. It includes two major categories of CALS projects:

- o New technology and infrastructure projects initiated directly in response to CALS to facilitate digital data interchange and integration. Program funding of $45 million includes:
  - The OSD program for developing and testing CALS standards and demonstrating digital data integration, access, and delivery.
  - Initiation of the design phase and a test bed activities for the Army CALS system which will provide digital interfaces to Industry and integrate current Army islands of automation.
  - Air Force CALS system integration designs.
- o Ongoing technology and infrastructure system modernization efforts which have been put under the CALS Steering Group oversight and directly support CALS objectives. Program funding of $75 million includes:

VUGRAPH 17 - FUNDING (Continued)

- Technology programs which will demonstrate potential solutions to CALS problems in product definition, electronic technical manuals, reliability and maintainability integration, or parts data access ($51 million).

- Infrastructure systems to automate engineering drawing respositories, other product data systems and automated publishing and technical manual management systems ($24 million). These systems have made commitments to incorporate CALS interchange standards.

Under the CALS Steering Group, technology and infrastructure system modernization programs are being coordinated to get a maximum return from the DoD investment. The CALS investment is enabling data interchange and access among contractor teams, as well as interchange between contractors and DoD. Thus, the CALS projects are leveraging both the multi-billion dollar DoD plans in overall infrastructure modernization and an even larger investment by Industry in their information and automation systems.

CALS program strategy is encouraging Industry investments in integrated processes on a productivity basis to meet design, manufacturing and data generation requirements and to respond to specific weapon system modernization programs. Incentives to accelerate Industry modernization include CALS requirements in competitive weapons system acquisitions and government funding for the Independent Research and Development (IR&D) and the Industrial Modernization Improvement Program (IMIP).

VUGRAPH 18 - APPLICATION POLICY

We are now going to discuss some aspects of CALS particularly germane to individuals in, or about to be in, major systems and major equipment program offices.

Policy guidance issued by the Deputy Secretary of Defense in August 1988 requires that:

- Systems and major equipments now in full scale development or initial production be reviewed for opportunities to improve quality or reduce costs by changing to digital delivery or access.

- Systems and major equipments entering development after September 1988 obtain competitive proposals for contractor integration, on-line government access to data, and digital data interchange.

- DoD Components program resources for automated systems to receive, store, distribute, and use digital data for weapon system and logistic support.

- The Under Secretary of Defense (Acquisition) issue further guidance on contract requirements, application to subcontractors and small business incentives and funding mechanisms.

In practical terms, the first two points state that OSD will not force backfitting on systems now in FSD or initial production, but programs entering development after September 1988 will be expected to implement appropriate CALS efforts.

The third bullet addresses infrastructure implementation, and the fourth point addresses various procurement aspects. We will address various contract issues later in the presentation.

VUGRAPH 19 - WEAPON SYSTEM CONTRACT - 1990s

This chart shows major CALS requirements for weapon system and major equipment contracts in the 90s. The contractor will be expected to describe his planned CALS effort in detail in his proposal.

CALS should be a factor in the DoD source selection criteria. Plans should include subcontractor coverage and other issues such as data rights, security, etc. The RFP should provide government plans for furnishing GFI in digital terms (if possible). Information should be available concerning government receiving systems capabilities.

The last two bullets address the specific functional capabilities and the type of logistics data products on which paperless delivery will be emphasized. The importance of these functional capabilities can be illustrated by fact that 30 percent of the life cycle cost can be directly traced to the R&M characteristics of the design. All of these requirements are not necessarily needed on an individual program. Functional capabilities are far more important on a major new design then a systems integration effort or NDI modification.

The movement toward functional requirements integration will ultimately result in such capabilities as:

- Automated generation of design alternatives
- Online access to prior designs
  - Drawings and specifications
  - Engineering changes
  - Production experience
  - Field reliability and maintainability data

VUGRAPH 19 - WEAPON SYSTEM CONTRACT - 1990s (Continued)

- o Algorithms relating design parameters to R&M, producibility
- o Integration of automated engineering analyses
  - Testability design and fault tree analysis
  - Reliability analysis and prediction
  - Finite element modeling
  - Thermal analysis
  - Development of maintenance requirements
- o Simulation of the design in maintenance environs
  - Access, clearances, human factors
- o Online manufacturing process planning and simulation

VUGRAPHS 20 AND 21 - CALS MAJOR THRUSTS - WHERE ARE WE GOING

The next two charts show some of the major thrusts on delivery and the evolution of requirements over time. Product definition data and technical manuals are the most expensive support products we buy. At one time, for example, the TM department was the largest department at McDonnell, St. Louis. The LSAR, although expensive, is cheaper than other alternatives, and currently provides data for most of the current ILS elements. In short, CALS takes aim at the more expensive ILS products. Much of the integrated data dictionary and automated tech manual processes exist today.

Note the possibilities for contractor maintained data bases, and on-line review and approval. On-line transmission of the full volume of technical data for major weapon systems is beyond the economical capability of current communication networks in DoD and industry. In the near term, CALS will accomplish bulk data transfers of engineering drawings, technical manuals and other voluminous documents via physical media, such as tape or optical disk. Many DoD acquisition centers are now planning to receive the LSAR master files on tape and run their own output reports. On-line interaction will be used primarily for lower volume transaction processing and data base access where operational requirements dictate and it is economically prudent.

The long range plan is to employ cost effective, secure high speed data communication network capabilities (both commercial and Defense Data Network upgrades) which are expected to be available in the future. Studies are underway to identify the most effective and efficient means for digital data transmission and communication.

However, on-line review, with reduction of time on-site by DoD review teams, will become more and more practical as CALS grows, since more and more of the data for review can be available digitally and communication costs will decrease.

VUGRAPH 22 - IMPORTANT IMPLEMENTATION CONSIDERATIONS

While the goals for progress are obviously ambitious, the OSD does recognize that implementation is a difficult process. This vugraph summarizes the remarks of Dr. Michael McGrath, Director of the OSD CALS Policy Office, made to the CALS EXPO 88 early in October 1988. The points on the vugraph illustrate that while OSD is aggressively pushing CALS, it also wants you to be realistic in application to defense contracts.

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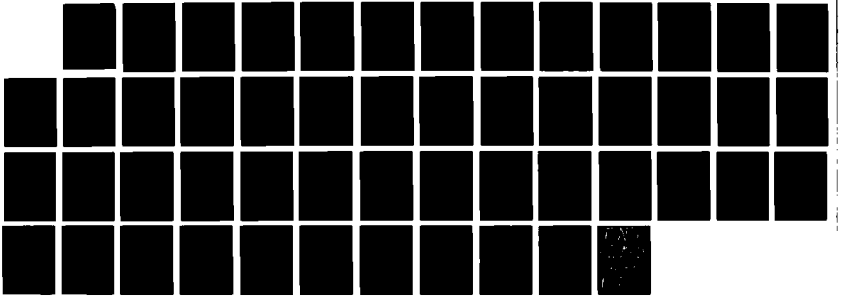

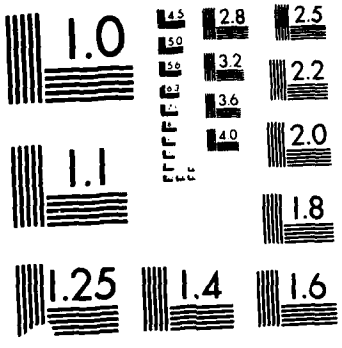

UTION TEST CHART

VUGRAPH 23 - WEAPON PROGRAM EXAMPLES

Several programs have already begun trial application of CALS technologies and integration approaches. CALS pilot programs include the A-12, ATF, and LHX aircraft (coordinated under the Joint Logistics Commanders), the SSN-21 submarine, and the V-22 aircraft. These programs provide demonstrations of data integration, on-line government access to contractor maintained data bases and digital data interchange, as discussed in Appendix C. Successfully demonstrated approaches will be used on these programs and others in the early to mid 1990's. Additional, nearer term, CALS applications are being planned on such programs as Joint Tactical Fusion, the Mine Countermeasures ship, and the B-2 bomber. More near term applications are being considered. The experience gained in these programs will significantly influence future routine contractual implementation of CALS. The paper in your handouts is an excellent example of the early kinds of effort required to achieve CALS objectives.

Comment - industry views the investments to be stimulated as DoD investments. Investment in the private sector is stimulated by perceived productivity benefits.

VUGRAPH 24 - V-22 CALS DEMONSTRATIONS

This chart illustrates in more detail the various areas being demonstrated on the V-22 OSPREY aircraft.

The project on feedback of operational data will establish interconnection between government and contractor data bases. It will develop a system to better utilize data such as 3M, safety, engineering investigations, and quality deficiency reports to help quantitatively substantiate the need for improved engineering and logistics design.

VUGRAPH 25 - ATF CALS DIRECTION

The Air Force Advanced Tactical Fighter (ATF) Project is one of the CALS major demonstration projects shown on one of the previous charts. The ATF is in DEMVAL phase. The contractor team includes Lockheed, Boeing, and General Dynamics. one of the requirements in this project is the demonstration and documentation of CALS benefits. A review of progress in this regard was held in late July and early August of 1988. The next series of charts shows the scope of this effort and some of the results to date. This chart summarizes the CALS capability build-up over time in this project.

VUGRAPH 26 - ATF FUNCTIONS SUPPORTED IN CALS ENVIRONMENT

Vugraphs 20 and 21 illustrated the main thrust of the CALS effort from a DoD perspective. The key targets listed were product data models, LSAR, Technical Manuals, other ILS elements, and R&M integration with CAD, CAL and CAM processes.

This chart illustrates the CALS impact from a prime contractors perspective. The obvious point is that CALS is or will impact many areas of contractor activity above and beyond the major thrust from a DoD perspective.

VUGRAPH 27 - CALS APPLICATIONS - COMPUTER MOCK-UP

This chart illustrates how CALS will foster greater supportability consideration in early design. Maintainability, supportability, and human factors considerations can be considered earlier than in the past. Computer simulations can be a major vehicle in this regard.

VUGRAPH 28 - COMPUTER MOCK-UP EXAMPLE

This chart shows a specific example of the benefits of computer mock-ups to foster parallel versus sequential design.

Historically the metal mock-up is fabricated after the design is completed. In the past, design data has been transferred manually to create analysis and manufacturing models. Retrofit design changes were uncertain because no engineering charts existed on the precise tube/wire harness routes through an aircraft. Supportability was an after-the-fact consideration.

VUGRAPH 29 AND 30 - R&M AVIONIC DESIGN PROCESS

The next two charts show how CALS will enable greater and earlier consideration of R&M in the avionics design process.

Since R&M can be related directly to as much as 30 percent of life cycle costs, earlier consideration can have a major impact on both cost and system effectiveness.

Vugraph 28 shows the historical R&M input occurring late in the design process, while vugraph 29 shows the dramatic change possible in a CALS environment.

VUGRAPHS 31 AND 32 - ATF CALS DEMONSTRATIONS

The next two charts summarize some of the benefits demonstrated at the mid-year 1988 ATF CALS review.

Vugraph 30 summarizes some of the savings demonstrated in the training development process, the provisioning parts list process, engineering release of spares order release, paperless order processing, on-line support equipment recommendation dates, and on-line contractor furnished equipment notice involving tech orders.

Vugraph 31 summarizes the increase in percentage of automation and connectivity in job planning/scheduling, the basic design process, and team member design interfaces.

VUGRAPH 33 -IMPLEMENTATION GUIDE

A key document for program office personnel is the draft CALS Implementation Guide. This was released in April 1988 for coordination. The initial version is expected to be published in December 1988.

This handbook provides guidance to acquisition managers who have responsibility for preparing contract requirements addressing (1) digital delivery or access to weapons system technical information, and (2) functional requirements for integration of contractor processes that create and use technical information. This includes:

o A description of the integrated, shared data environment toward which CALS is targeted, and guidance on the contractor proposals and plans for creating and using such an environment that should be required by the government.

o Generic guidance, which is then tailored by application area, addressing the acquisition of digital data. In any application area there are a number of issues -- policy, technology acquisition phase and status, data use -- that must be considered in determining whether to buy data products or data access, the appropriate data form, the relevant standards and specifications, and the delivery or access mode. The application areas addressed in the Phase I.1 release of MIL-HDBK-CALS include:

- Technical manuals
- Technical data packages, including engineering drawings, specifications, and book-form drawings
- Logistic support analysis record data
- Training materials

o Guidance on delivery or access mode requirements, such as magnetic tape physical media for data delivery, and Defense Data Network/Open System Interconnection compatibility for online access.

VUGRAPH 33 -IMPLEMENTATION GUIDE (Continued)

o Functional requirements for integration of contractor processes, with an initial focus on improvements in early reliability and maintainability (R&M) design influence through integration of R&M with computer-aided design and engineering (CAD/CAE). Instructions to offerors would require contractor proposals, which would be given significant emphasis during source selection and then contractually required.

o Discussion of data base and telecommunication security considerations, data rights in a digital environment, and related acquisition issues.

The handbook is explicit in terms of current limitations. For example, today's computers generally still handle textual data quite differently from graphics, and this causes difficulty in producing and maintaining integrated narrative and illustrative material in technical manuals. The guide will be expanded to cover additional functions as part of the planned incremental releases of the CALS standards and specifications.

The key word is guide. It should be used to assist in determination of specific contract requirements. It should not be invoked blindly. This guide will obviously be updated as CALS evolves and experience gained, but, the present draft is an excellent starting point.

VUGRAPH 34 - DECISION TEMPLATE

This vugraph shows the master decision template contained in the guide for systematic determination of how product data should be delivered to the government by the contractor. The decision points on the template are not always exclusive and indicate a range of alternatives open to the Acquisition Manager. That is, selecting one option at a decision point for a particular data product does not necessarily prohibit the selection of other options for that same or other data products. On each weapon system program, the delivery media and technical use for each data product contract line item and CDRL item must be carefully evaluated. That evaluation process involves making four sets of decisions as shown in the template. The handbook tailors the master template shown for the following subjects: technical manuals, engineering drawings, specifications and standards, the LSAR, and training products. It provides guidance for each subject such as intended data use, life cycle phase, delivery costs, and available technology.

VUGRAPH 35 - DATA USE CATEGORIES

The acquisition manager must consider how data will be used in order to make good decisions on digital data requirements and format. The five defined categories of data use typical of most weapon system programs are archive, view, annotate/excerpt, update/maintain, and transform. They have been sequenced by level of sophistication from simple archiving to very complex information processing and transformation.

Archive. Archiving is the placing of data in a respository to preserve it for future use. Data may be archived in hard copy; however future use of the data are enhanced when the data are prepared in digital form on media that allows electronic retrieval. Digital data storage is also much more space efficient than any hard copy storage media. Legal questions remain on the certification of "originals" for other than hard copy, and use of digital deliverables may be limited when applied to certain contract administration and accounting functions. Early identification of the repository for each life cycle phase is desired to build the foundation for government and industry access as required to support the weapon system.

View. View is the ability to examine a data file without the ability to change it. It is the traditional service offered by early ADP systems. It normally offers the options of screen display or hard copy output from a printer. Modern workstations and terminals, however, often include a local storage device, i.e., either a hard or "floppy" disk drive, so that anything displayed on the screen or output to a printer or plotter can be stored locally for later retrieval at the workstation without reestablishing a connection with the host computer.

VUGRAPH 35 - DATA USE CATEGORIES (Continued)

Annotate/Excerpt. Annotate/excerpt is the ability to evaluate and highlight for future reference or to make annotations, approvals, and comments without the ability to change the original file. The extraction of relevant data for use in other documents, or for summarization purposes, is also provided at this level. The essential difference between "annotate/excerpt" and "view" is that annotations can be returned as either an "overlay" file, for direct incorporation or by word processing software, or a duplicate original, i.e., "back up," file to the host computer. This effectively allows a "change" to be made to the data. If there is need to maintain an audit trail to the composition of the original document, the acquisition manager should plan to archive these overlay and backup files or require the contractor to do so through appropriate contractual tasking.

Update/Maintain. Update/maintain is the ability to change data, either directly or through controlling software, in the live files on the host computer. An example of this data use type would be updating the GFE portion of an assembly drawing and associated parts lists. The service life of weapon systems may extend for 30 years or more; this longevity means that the supporting data has a similarly long life during which it must be updated and maintained. Special emphasis must be placed on configuration control.

Process/Transform. Process/transform is the ability to extract and modify the format, composition, and structure of the data into another usable form. Process/transform is the most complex "use" of product data. For example, Computer Aided Design (CAD) data may be transformed into Computer Aided Manufacturing (CAM) data for making spare parts on numerical control machines, or technical manual text and graphics data may be transformed into very specific troubleshooting maintenance aids for weapon system repair.

VUGRAPH 36 - POSSIBLE CALS RFP CONTENT - GENERAL

CALS SOW requirements can be categorized as general or programmatic and specific - for example, technical manual CALS requirements. This chart addresses possible general requirements.

Contract Implementation of Digital Data. The contractor should be required to provide a comprehensive and detailed plan per contract and CDRL requirements outlining the procedures and specification to be utilized in the integration, digital exchange and sharing of data with the government and contractor(s). The data base(s) must have the capability of distinguishing between and providing visibility and accessibility of the following data interactions:

- Working Data - Government should be provided a "read only" capability for selected initial or change data/information as may be negotiated.

- Submitted Data - These submitted data must provide a method for incorporation of proposed changes by the government.

- Approved Data - Data that have been reviewed and approved by the government or appropriate designee.

The plan should address capability for electronic demand reproduction of CAE/CAD/CAM/logistics technical data and provide for the digital exchange and integration between the logistics and other technical areas.

Supplier/Vendor/Subcontractor Data Requirements. The contractor should be required to describe his plan for capture and incorporation of supplier/vendor/subcontractor required data. This should consider the capability of the supplier to deliver required data by electronic digital means compatible with the prime contractor's procedures, and should describe approaches to providing terminals and/or access to lower tier subcontractors.

VUGRAPH 36 - POSSIBLE CALS RFP CONTENT - GENERAL (Continued)

Government Furnished Information (GFI). An important asset of data required to support the acquisition of weapon systems is generated by the government and provided to the contractor as Government Furnished Information (GFI). The acquisition manager should provide GFI in digital form whenever possible. Requests For Proposal (RFPs) should specify contractor responsibilities for the integration of GFI with contractor-generated data in preparation of documents, processable files, or data bases for interactive access.

Data Rights and Control. DoD policies and acquisition regulations regarding data rights and control in the paper-based environment also apply to the CALS digital environment. Control of the data base and the associated data maintenance and configuration control responsibilities are important issues. These issues require consideration in the design of Contractor Integrated Technical Information Systems (CITIS) which must include restricted access procedures and electronic marking of digital deliverables. Acquisition managers should require the contractor to provide a comprehensive and detailed plan that describes the procedures and specifications for use in the integration, digital exchange, and sharing of data with the government and other contractors, including satisfactory security requirements.

Industry. Defense contractors may choose to limit the access to data documenting products and procedures for which the government does not possess the data rights. In addition, much of the data documenting weapons systems is subject to technology transfer programs, such as the Arms Export Control Act, that imposes restrictions on free release of such data. Contractors must develop and follow procedures which ensure that digital data delivered to, or accessed by, the government are properly marked and that controls and safeguards in the digital environment provide at least the level of protection provided in the paper-based environment. Where clas-

sified information is developed or used by industry, additional oversight, programmatic controls, and specific procedural handling of this data will be imposed by the acquisition manager who will be supported by an extensive community of security organizations. Procedures for managing classified information are extensive, but selected areas that require review during the planning for acquisition of classified digital information are discussed in appendix E.

Government. The government must identify during acquisition planning what procedures should be developed for effective management of classified, sensitive, or limited rights data. Successful implementation will require clear contractual agreement on how these data will be safeguarded, both by the contractor and subsequently by the government. In addition, where government access of a contractor data base is desired, contractors will be concerned about government access to data that have not been validated by the contractor. In such cases the government should consider acquiring access to a separate "delivered in place" data base of validated data maintained by the contractor, until proven procedures are developed for managing government access to contractor's data systems.

VUGRAPH 37 - LSAR OVERVIEW

The Logistic Support Analysis (LSA) builds upon data from related systems engineering and design analyses and produces a consolidated and integrated set of logistics-related technical data. The resulting Logistic Support Analysis Record (LSAR) is an integrated data base consisting of both the engineering source data upon which the analytical tasks are based and the analysis results are documented. MIL-STD-1388-2 defines the format and content of the LSAR and the structure of various standard reports that allow digital delivery of the data.

A baseline LSAR system, the Joint Service LSAR ADP System, has been developed as one alternative for LSA automation. This batch mode system satisfies the requirements of MIL-STD-1388-2, but lacks many desirable features and capabilities afforded by current technology. Many contractors have augmented the Joint Service System by adding front-end software to improve data entry efficiency. Others have used data base management software to make the data accessible to both on-line inquiries and various LSA software tools. Finally, some contractors have linked software tools for other engineering, design, and Integrated Logistic Support (ILS) functions to the LSAR to use or update LSAR data.

VUGRAPH 38 - CALS LSAR DECISION TREE

Decision Option Discussion. The master Decision Template for Acquisition of Digital Deliverables as applied to the LSAR is displayed in this vugraph. The deliverable alternatives are not mutually exclusive and may be combined. However, the early selection or rejection of an option for one deliverable may cause that option to be included or excluded, respectively, for other deliverables.

Deliverable Options - Decision #1. LSAR data can be delivered as LSAR reports, LSAR data files, or through interactive access to a contractor LSA data base. All three options encourage a contractor automated LSAR. The requirements for LSAR final deliverables will likely be a combination of at least two of these options.

LSAR Reports. The first option, LSAR reports, includes the 74 reports contained in appendix B of MIL-STD-1388-2, plus any project-unique reports that can be produced using LSAR data and are defined by the LSA program contract requirements. Most reports allow refinement or focus for a specific user by tailoring or reformatting. Many of the reports are designed as analysis and data review tools and are not intended to be deliverable products. LSAR reports are static presentations for LSAR data and cannot be updated or processed further after delivery. They offer the least flexibility for LSAR data use. Therefore, requiring LSAR reports as a deliverable option is appropriate only for on-time deliveries or when no further processing capability is available.

LSAR Data Files. LSAR data files, the second option, include the three LSAR master files and other LSAR data files that require processing after delivery (such as input files for Provisioning, DLSC Screening, or Packaging Systems, among others). An internal data processing capability is required for each LSAR data file. Delivery of the LSAR master files provides the capability to subsequently produce any and all of the LSAR reports and other data files and provides the historical baseline data for weapon

system/equipment. Separate delivery of other LSAR data files places responsibility for their generation with the contractor rather than the government. Because of the flexibility provided by these processable data files, they can be used to satisfy both interim and final LSAR delivery requirements. Periodic delivery can reduce time spent for on-site data reviews by providing a vehicle for advanced review of data. Final contractor deliverables can be consolidated and reduced by use of internal processing of LSAR data files, in part or in total.

Interactive Access. The third LSAR deliverable option is the use of interactive access to a contractor's LSA data base. Interactive access includes the ability to selectively retrieve, review and print, and process contractor LSA source data. Interactive access for faster government review of LSAR information represents more of a contractor service capability than a specific deliverable requirement. This capability makes the most current authorized data available to the government and eliminates the time required for preparation and submission of deliverable products. It can also significantly reduce the time requirement for on-site reviews, while supporting internal analyses and planning that requires up-to-date supportability information. Interactive access provides the greatest flexibility for using LSAR data, either by utilizing the contractor's automated LSAR capabilities or by electronically transferring the data for future internal processing. Since interactive access can support interim and final delivery of both LSAR reports and data files, it may entirely eliminate the need to bring the LSAR data in-house. However, it is advisable to have LSAR master files delivered at contract completion. The interactive access service can be very effective for satisfying LSAR deliverable

VUGRAPH 38- CALS LSAR DECISION TREE (Continued)

requirements during the early life cycle phases when the volume of LSAR is low. In latter phases, interactive access may be more appropriate as a contact compliance, data review, and internal analysis tool rather than for bulk transfers of complete LSAR master or other data files.

Form - Decisions #2. As shown on the vugraph LSAR reports can be delivered either as hard copy reports or as a report image file. Hard copy reports are computer-generated LSAR reports (Appendix B of MIL-STD-1388-2) and program-unique LSAR reports. Report image files, the digital equivalent of these reports, require no further data processing and can be loaded, viewed, and printed using standard system utilities. Both options are a fixed presentation of the LSAR data and the applicable DIDs must be selected for the desired reports. If the hard copy form is selected, the DID hard copy option should be noted.

Interactive Access. As shown at the bottom of this vugraph, interactive access to a contractor's LSA data base can take two forms: predefined queries or ad hoc queries. A predefined query is a set structure or summary of LSA source data. All of the LSAR reports including program-unique reports contractually required, as well as LSAR master files and data files, can be described as "predefined" in this context. With the format, content, and options already having been specified, the user selects that file or report (usually via a menu choice) to be accessed. Ad hoc queries allow the aggregation and presentation of a contractor's LSAR source data to be defined by a user during an on-line session with the contractor's system. The ad hoc query capabilities are governed by the specific technologies and software of the contractor's system. As CALS data standards for LSAR are developed, this limitation may be altered, as reflected by the dashed line for data standards at the bottom of this vugraph. Until then, although the ad hoc query

capability can be identified in the LSA SOW, it can only be defined by a contractor's proposal. Care should be exercised in evaluating contractor proposals to ensure that the proposed ad hoc query capability will satisfy the program office requirements.

Specifications and Standards - Decision #3. There are no decision options on the standards for LSAR reports or LSAR master data files. These files are all alphanumeric tabular data files as specified in MIL-STD-1388-2.

Deliver Mode Options - Decision #4. As shown at the right of vugraph, there are two delivery mode options for LSAR report image files and for data files: physical media delivery or telecommunications transfer. Physical media consists of data delivered on magnetic tape. Telecommunications involves the bulk electronic transfer of data files using a specific telecommunications standard and a government, public, or contractor-specific telecommunications network. If interactive access is not chosen for interim reviews, the final delivery of LSAR reports and data files should be magnetic tape, because the cost to establish an interactive access capability for final deliverables only is probably prohibitive. When an interactive access capability will be established, the cost and accessibility benefits of telecommunications versus physical media deliver modes must be evaluated. For physical media delivery, use existing or program-unique DIDs and indicate the tape delivery option. Reference the tape media standards contained in the Contract Requirements for Deliver Modes appendix of this Implementation Guide. For telecommunications delivery of LSAR report image files or data files, the reports for data files to be electronically transferred should be included in the LSA program SOW.

VUGRAPH 38- CALS LSAR DECISION TREE (Continued)

Interactive Access. For the interactive access service, the only deliverable mode option is telecommunications. Options for selection of a telecommunications standard and delivery network are listed at the end of the telecommunications branch on the vugraph. The choice depends upon the volume of data to be transferred, as well as the technologies in place at the contractor and the government facilities.

Queries. If predefined queries are selected as the access form, the LSAR reports and files and the telecommunications standard should be included in the LSA program SOW. If ad hoc queries are chosen, the LSAR program SOW must contain appropriate language without delineating specific report and data files. If both predefined and ad hoc queries are required, include this in the LSA program SOW and indicate the LSAR report and other files to be accessed. Paragraph 50.4.4 of the handbook has sample SOW paragraphs.

VUGRAPH 39 - LSAR DECISION GUIDELINES - INTENDED USE

Decision Guidelines. Digital deliverable options for LSAR are not mutually exclusive. There will often be cases when several options will be combined for specific deliverables during a weapon system acquisition. The next series of charts presents general guidance from the Implementation Guide on intended use, life cycle phases, delivery costs, and available technology.

Intended Data Use. The following guidelines apply:

a. Select LSAR data files for consolidation of deliverables.

b. Select LSAR data files if significant internal analysis of the data is anticipated.

c. Select LSAR data files for input to automated governmental support systems.

d. Select interactive access with predefined queries to review LSAR data.

e. Select interactive access with ad hoc queries to support unique analysis or delivery needs.

VUGRAPH 40 - LSAR DECISION GUIDELINES - LIFE CYCLE PHASES

The following guidelines apply:

a. Select LSAR hard copy reports for early phases with low volumes that do not justify the cost of additional automated processing.

b. Select LSAR hard copy reports for nondevelopmental programs with a limited service life requirement.

c. Select LSAR data files for later, high volume phases.

d. Select interactive access to replace early phase LSAR deliverables.

e. Select interactive access to support LSAR data reviews in all phases.

VUGRAPH 41 - LSAR DECISION GUIDELINES - DELIVERY COSTS

The following guidelines apply:

a. Select LSAR report image files if multiple report copies are required.

b. Select LSAR data files, in general, as the most cost effective option for all deliverables.

c. Select interactive access to minimize on-site review requirements.

d. Select magnetic tape for delivery of high volumes of digital data.

VUGRAPH 42 - LSAR DECISION GUIDELINES - AVAILABLE TECHNOLOGY

The following guidelines apply:

a. Select LSAR hard copy reports or interactive access if no internal data processing system capabilities are available.

b. Select LSAR report image files or interactive access if only limited internal data processing system capabilities are available.

c. Select LSAR data files for Full Scale Development or Production phases if internal data processing capabilities are available or planned for that time.

VUGRAPH 43 - LSAR DELIVERABLES

Automation and telecommunications technologies, which provide extended capabilities to industry and government, are altering the ways in which LSA and LSAR reporting and use are performed. The prior discussion of decision choices on the LSAR decision template indicated that there were six basic, yet non-exclusive, digital deliverable alternatives. These alternatives require that specific procedures be established for LSAR configuration management, interactive access controls, government review and feedback, and product delivery. The alternatives associated with telecommunications assume that an interactive access capability exists for LSAR report fields. When existing functional standards are insufficient to describe the appropriate methods to contractually invoke these alternatives, new SOW language must be provided. Each alternative has specific SOW language that should be included in the LSA program SOW. Sample SOW's are provided in the handbook to implement the alternatives as summarized in the vugraph.

VUGRAPH 44 - R&M INTEGRATION - GENERAL BACKGROUND OVERVIEW

Impact of R&M. R&M has decisive influence on weapon systems acquired by DoD. It is therefore important that R&M data be automated and integrated into the CALS program.

R&M influence on effectiveness. Weapon system R&M characteristics influence its operational effectiveness by driving its readiness for battle; sustainability during battle; and utilization of personnel and material during training and battle. It is recognized that good R&M are force effectiveness multipliers by offering the means to defeat a numerically superior force by engaging it repeatedly. Reliable weapons systems result in increased combat capability while employing fewer fielded spare parts and less manpower. Similarly, maintainable systems require that fewer people and specialized skill levels be fielded while achieving reduced maintenance times. Good R&M improves the mobility of forces because there are fewer people and less support equipment and spares to move. In short, the R&M features of each weapon system contributes significantly to the conflict capabilities of forces at sea and in the field.

R&M influence on life cycle cost. The R&M characteristics of a weapons system are also key leverage points in determining the weapon system's total life cycle costs and operational effectiveness. An estimated 30 percent of life cycle costs can be traced directly to R&M characteristics of the weapon system's design. These costs occur not only as budgeted line items in the procurement and operations and maintenance appropriation of the particular weapon system, but also as indirect costs of the supporting logistics facilities and activities, manpower, attrition replacements and replenishment spares.

R&M in the design process. While conventional stand-alone, post design R&M "engineering" tasks, such as test, analyze, and fix (TAAF), have been moderately successful in achieving improved R&M,

these approaches are fundamentally limited by their inability to influence the design process itself. The R&M characteristics of a weapon system are, to a large extent, attributes of its design, or more precisely, a direct function of the attention given to them in the design process. They are analyzed into the design after it has been completed only with great difficulty and cost. Additionally, the R&M improvement effort must compete with integration and operational testing of test resources and schedule.

CAE in Development. The application of R&M-specific CAE resources to weapon system programs in an integrated development environment have the potential for effecting a quantum improvement in their R&M characteristics. CAE, when applied to R&M design, will provide the designer with close-coupled, short-cycle analysis and feedback about the efficacy of the design approach in a time frame permitting corrective action and optimization during the design process rather than later. In addition, concurrent design synthesis techniques provide a superior inherent design capability with respect to reliability and maintainability.

Contrast of Traditional and Integrated. Traditional R&M requirements take the form of independent tasks to be performed by the contractor as detailed in the contract Statement Of Work (SOW) and any R&M-related attachments and exhibits. The results of these tasks are to be delivered in accordance with the contract Deliverable Requirements List (CDRL) in the format specified by a Data Item Description (DID). The integrated R&M functional requirement is different in that it places an indirect requirement on the contractor's engineering resources, in the form of R&M-specific CAE

VUGRAPH 44 - R&M - GENERAL BACKGROUND OVERVIEW (Continued)

techniques, procedures, and data bases. This indirect requirement necessitates a different contracting approach than does traditional R&M tasking but is consistent with streamlining and allows the contractor more freedom to determine how he will satisfy the government's requirements. It replaces emphasis on specific SOW tasking with increased emphasis on the use of the instructions to offeror and source selection criteria to cause the contractor to tell the government how integrated R&M specific CAE is to be applied to the program being bid.

VUGRAPH 45 - ACHIEVING THE POTENTIAL OF CAE AND R&M

Achieving the Potential of CAE. Achieving the full potential of integrated R&M-specific CAE requires more than the use of automated "tools" to conduct conventional R&M analysis tasks such as MIL-HDBD-217 predictions. It also requires improvements in five areas:

a. Automated R&M analysis procedures tightly coupled to the parts libraries and materials characteristics data bases.

b. Automated R&M synthesis processes based on design rules incorporating lessons learned from prior design experience and field use.

c. Fully characterized (tested and validated) component performance and R&M characteristics data bases.

d. Configuration management procedures that link major design decisions affecting the R&M characteristics of the end item to the CAE software and data bases used to develop decision criteria and otherwise support the decision.

e. Supporting structure of hardware, software, and computer networks adequate to support the procedures and processes of (a) through (d) above and to closely couple the R&M specific resources (including personnel) with the rest of the design team.

Goal of R&M-Specific CAE. The ultimate goal of the integration of R&M into CAE is for all major design decisions affecting the R&M characteristics of the end item to be fully supported by automated procedures appropriate to the nature and level of the decision in a concurrent or near-concurrent fashion.

VUGRAPH 46 - SUGGESTED RFP AND SOURCE SELECTION PROCESS

The following guidance is provided on contracting for integrated R&M data.

Approach. A two-step approach is provided as the mechanism for the program office to obtain automated R&M functions as part of the contractor's engineering effort.

Instruction to Offerors. Section L (Instructions to Offerors) of the Request for Proposal (RFP) should require the contractor to:

a. Identify its capability and experience in the use of automated R&M functions

b. Explain to what extent R&M design tasks are integrated with its CAE system

c. Describe how it will use its R&M-specific CAE techniques, processes, and data bases to satisfy the RFP requirements

Evaluation Criteria. Section (M (Evaluation Criteria) should be structured to emphasize these three issues.

Contract Requirements. Contractor responses to Section L of the RFP should be used in final negotiations with the winning contractor. The object is to incorporate, as contract requirements, proposal items that the government and contractor believe will provide significant benefits to the design in terms of R&M performance. As contract requirements, the chance of R&M CAE functions being eliminated due to pressures from other program elements (e.g., costs, schedule) should be minimized.

VUGRAPH 47 - DELIVERY MODES AND SECURITY

Deliver Modes. Contract requirements for delivery modes for physical media and for telecommunications is contained in Appendix D of the Handbook. The telecommunications area is expected to undergo major change in terms of cost in the coming years.

Security. Is discussed in Appendix E of the Handbook.

Government Security Issues. Technical and logistics data generated in support of a weapon system acquisition program will range, in the area of security sensitivity, from unclassified to For Official Use Only (FOUO), subject to export control, industry/corporate proprietary/source selection sensitive, and classified from a national security standpoint, (e.g. confidential, secret, top secret, etc.). Although the bulk of data will usually be unclassified, the accumulation of data, or "data aggregation", and the inferences which can be drawn from it may dictate a higher level of classification. The delivery mode(s) selected for the transmission of technical data to the government must provide a level of protection commensurate with the data's level of sensitivity. Multiple delivery to an unclassified technical manual may be delivered in hard copy while the main body of the technic l manual is delivered as a processable data file. With potential for interactive access to weapon system data, provisions for access control and telecommunications security must be addressed in accordance with DoD and NSA regulations and instructions. The procurement must clearly state what degree and levels of access will be required.

Industry Security Issues. In addition to providing security to technical data at a level commensurate with government designated level of sensitivity, industry must deal with company proprietary, competition-sensitive, or liability sensitivities of data. It is the responsibility of the contractor's facility even if government personnel have interactive access capability.

VUGRAPH 47 - DELIVERY MODES AND SECURITY (Continued)

Telecommunications. The interrelationship and interdependency between telecommunications and computer systems are defined by NSDD 145, "National Policy on Telecommunications and Automated Information Systems Security." Government agencies and systems security steering groups, including the National Computer Security Center, were chartered to establish policies standards, products, and technic l/research centers. Encryption of classified data shall be in accordance with procedures established by NSA. Encryption of other sensitive data shall be by commercial practice commensurate with level of sensitivity.

Computer Security Levels. Information processing products are evaluated for determining their level of capability to protect information from unauthorized access against requirements set forth in DoD 5200.28-STD, "The DoD Trusted Computer Syst ms Evaluation Criteria." One of the levels of information security is broadly categorized as "system high". An information system that is operating at "system high" requires that all users with physical access to that system have a current security clearance equivalent to, or greater than, the highest classification level of any data resident on that system. A second level of information security is categorized as "multilevel security." An information system that is operating at "multilevel security" allows system access to users who have security clearances that are at a lower level than some of the data resident on the system. A "multilevel security" system must therefore protect information from unauthorized disclosure to individuals who have a lower security clearance, but who are authorized to access the system. All options and alternatives to multilevel security, including multiple physically isolated data bases, must be considered.

VUGRAPH 47 - DELIVERY MODES AND SECURITY (Continued)

Security Requirements.

Industry. Appropriate security measures and standards are required when proprietary or technologically sensitive acquisition and logistics data are electronically/digitally created, changed, transmitted, received, and stored. Effective industry application depends in part on the degree of confidentiality warranted by the security requirements and their implementation and enforcement. In order to obtain early visibility and management of security issues, it is important that a security plan be developed in response to anticipated weapon system program requirements as part of offeror's proposals in response to an acquisition RFP. This plan should address levels of security for each access mode and procedures to protect classified data with particular attention paid to interactive access of data bases and telecommunications.

VUGRAPH 48 - IDENTIFICATION OF SECURITY BY DATA ITEM

Government. Since CALS forces delivery use and dissemination of industry developed data beyond the control of the owner, the access and control of this contractor information must be maintained through the use of DoD-wide uniform standards. Security requirements will increase significantly as CALS includes more classified information and employs more automated systems to originate, communicate, and receive data. It is the responsibility of the program office to identify anticipated security levels by data item as summarized in this vugraph.

Considerations for Security Implementation.

Industry. In the implementation from hard copy to CALS Phase I and Phase II, the security requirements for the protection of proprietary information will increase in sophistication and cost in proportion to the level of access control required. Access control issues exist at the sending and receiving sites and the telecommunication links connecting them. Minimum security standards should be established early in the program in accordance with CALS technical data security plan as approved by the program office. Access controls should be established in accordance with this plan.

Government. CALS information security must be addressed in accordance with the Industrial Security Manual, DoD 5220.22-M. The process for establishing information security requirements is as follows:

a. Establish security requirements using "Guidance for Applying the Department of Defense Trusted Computer System Evaluation Criteria in Specific Environments,"

VUGRAPH 48 - IDENTIFICATION OF SECURITY BY DATA ITEM (Continued)

CSC-STD-004-85. For a given maximum data sensitivity and minimum clearance or authorization of a system user, a computer security category, ranging from C1 to A1, is defined.

b. Use the DoD Trusted Computer System Evaluation Criteria (DoD 5200.28-STD) as a source for information processing product evaluation. The Evaluated Products for Trusted Computer Systems is prepared by the National Computer Security Center.

c. after definition of information security requirements by dod weapon system and data system acquisition managers and by security managers, requirements are passed to industrial supported by dd form 254, dod contract security classification specifications.

VUGRAPH 49 - GROWTH IN BENEFITS

This chart conceptually summarizes several key points. The first is the interaction and the continuing evolution of CALS due to progress in the standards, technology demonstrations, etc.

The second is the increasing growth of the benefits in terms of dollars, time, or readiness over time to DoD programs as technology and implementation matures.

VUGRAPH 5Ø - TECHNICAL ASPECTS

The next few charts will briefly summarize some of the technical aspects of the program. Needless to say, these aspects are the heart of the CALS effort since they will provide the comm^n interface needed for industry and DoD to effectively interchange and use digital data.

A brief word about the specifications and standards before we get into the detail. The standards involved w ll go through a maturation period. For example the IGES specification, for graphics exchange, and the specification used on the SSN-21 program, first issued in 198Ø, has had five updates before its content was frozen. Thus the benefits from these documents will increase both because of document improvement as well as wider application.

The Air Force AFTOMS Automation Plan, a copy of which is in the library, has excellent discussions of the expected technology improvements in areas such as automated reading of paper documents, mass storage, computer based printing, and hypertext and videodisc systems.

VUGRAPH 51 - INITIAL CALS STANDARDS

The CALS standards and specifications are being developed incrementally. The initial increment, called the Phase 1.0 Core Requirements package, was developed and coordinated during 1987. The 1988 increment, called the Phase 1.1 Core Requirements Package, has been released for formal DoD and industry coordination and will be published by December. Development of the Phase 1.2 standards and specifications is underway for coordination during 1989. Documents released to date include:

MIL-STD-1840A, "Automated Interchange of Technical Information." MIL-STD-1840A is the parent document for the other CALS standards and specifications. It provides rules for organizing files of digital data into a complete deliverable document, using the supporting CALS military specifications -- MIL-D-28000 for IGES product definition data, MIL-M-28001 for SGML text data, MIL-D-CGM for vector illustration data, or MIL-R-RASTER for Raster illustration data.

MIL-D-28000, "Digital Representation for Communication of Product Data: IGES Application Subsets." MIL-D-28000 defines a series of application-specific subsets of the Initial Graphics Exchang Specification (IGES), the popular name for American National Standard ANSI Y14.26M, "Digital Representation for Communication of Product Definition Data."

MIL-M-28001, "Markup Requirements and Generic Style Specification for Electronic Printed Output and Exchange of Text." MIL-M-28001 defines standard DoD requirements for automated publishing of page-oriented (i.e., printed) technical manuals and technical orders. It defines a common DoD-wide implementation of International Standard ISO 8879, "Information Processing - Text and

VUGRAPH 51 - INITIAL CALS STANDARDS (Continued)

Office Sys- ms - Standard Generalized Markup Language (SGML)." It also defines typographic tags and format rules for document composition, and options for use of commercial page description language products.

MIL-D-CGM, "Digital Representation for Communication of Illustration Data: CGM Application Profile." MIL-D-CGM defines an application profile for delivery of technic l manual illustration using the Computer Graphics Metafile (CGM). CGM has been published as International Standard ISO 8632, American National Standard ANSI X3.122, and Federal Information Processing Standard FPS 128.

MIL-R-RASTER, "Requirements for Raster Graphics Representation in Binary Format." MIL-R-RASTER defines engineering drawing and technical manual illustration requirements for Raster graphics compressed in accordance with International Standard CCITT T.6, "Facsimile Coding Schemes and Cod' g Control Functions for Group 4 Facsimile Apparatus," and FED-STD-1Ø65.

VUGRAPH 52 - STANDARDS IN DEVELOPMENT

This chart shows examples of work now underway to define CALS Phase 1.2 and Phase II Core Requirements to broaden the application environment for the current CALS standards, and in selected cases define requirements for additional digital data interchange and access standards. Examples include:

- The Office Document Architecture and Interchange Format (ODA/ODIF) for presentation and layout, and the Standard Page Description Language (SPDL) for image delivery, of technical publications

- Various additional candidates for exchange for product definition data for electronics, such as the Electronic Data Interchange Format (EDIF), the VHSIC Hardware Description Language (VHDL), and the Integrated Printed Circuit (IPC) standards

- The Information Resource Dictionary System (IRDS) for management of data element definitions and their relationships, and the Structured Query Language (SQL) for data access

- The Product Data Exchange Specification (PDES) which will encompass the complete set of data elements that defines a product for all applications over its expected life cycle

The work to develop CALS implementations of these current and future industry standards is being accomplished jointly by DoD, National Bureau of Standards (NBS), and by industry users and vendors.

VUGRAPH 53 - TECHNOLOGY DEVELOPMENT AND DEMONSTRATION PROJECTS

To further illustrate the magnitude of the CALS technical efforts, the next two charts show the number of such projects and the year of expected initial results. The individual projects are described in the appendices of the CALS report to Congress. Some copies of this report are available if you desire one.

The projects cited are representative rather than all-inclusive, since assignment of projects as part of CALS or other automation projects can change from year to year. These projects represent candidate CALS technical approaches or standards, are providing early experience using CALS product data standards, or are involved in the identification of data requirements and interfaces.

The Navy Mine Countermeasures Ship (MCM) project, for example, is developing specifications for product modeling which includes a 3D graphical solid presentation integrated with other logistics and analytic files to provide a complete integrated data set.

The DLA Government Furnished Baseline (GFB) project will provide a prototype capability for industry and military activities direct access to the DLA electronic and mechanical parts data bases.

The 1988 DLA CALS Program Implementation Plan, a copy of which is in the library, has an excellent discussion of all the DLA CALS related projects.

VUGRAPH 54 - CALS ARCHITECTURE AND INFRASTRUCTURE IMPLEMENTATION

This chart shows the number of projects and timing of projects associated with CALS architecture and infrastructure implementation. Again they are each described in your handout. Note the heavy activity in engineering data repositories and product data and automated publishing and paperless TM systems.

One of the questions frequently raised is - can benefits be obtained by eliminating duplication between some of these projects? This question is being addressed.

During the last year, OSD had led the components in a series of planning sessions to more clearly define the scope of CALS and coordinate on-going problems. Planning sessions over the next year will continue to define areas where corporate DoD solutions are needed as distinguished from those where Component-specific solutions are appropriate. To support this effort, a top level functional review of each Components programs and processes that relate to CALS has begun, using a formalized systems architecture development approach. This approach will define corporate elements of the CALS "system of systems" in terms of the required data, the functions, and the network architecture. Architectural guidelines based on this structured approach will be available in June 1989, and will address elements critical to CALS Phase II, such as the indexing and locator system for accessing data in a highly integrated, but geographically distributed, data base environment. These elements will be corporately developed to insure consistent CALS implementation within DoD and Industry.

The final point to be made on the last two charts is timing. While the year cited for each project normally represents initial results, most of these projects fall in the near time frame. Thus many of these projects, could impact systems and major programs now in concept formulation or advanced development.

VUGRAPH 55 - CALS STANDARDS IMPLEMENTATION STEPS

Many of you may have had some past experiences attempting to transfer data which could lead to questioning the efficacy of such data transfer. For example several years ago, I was totally frustrated when I tried to transfer a DECMATE disc to a WANG disc. I finally resorted to a scanner which still required a fair amount of rework. This year we more successfully used a WANG conversion program, but we still lost the word processing format control functions.

Good standards are key to making CALS effective. At least one expert believes testing represents 25% of the effort to get a good data interchange standard. Agreement on a specification is only 25% toward a workable standard. In recognition of this a major testing effort is underway.

The National Bureau of Standards is developing the necessary conformance tests needed to evaluate vendor compliance with CALS Standards as they are published. However, conformance tests are only the first level of testing required to assure that digital data exchange standards adequately support user requirements for end-to-end data transfer and provide the necessary feedback for standards update. As testing and trial implementation takes place, planning for DoD and Industry infrastructure modernization continues. The sequence of the steps for implementation of standards is illustrated in the vugraph.

OSD has designated the Air Force as lead service in creating a DoD and Industry distributed test bed network for comprehensive testing of the CALS standards in user applications. By linking existing nodes in DoD and Industry, the investment in the network will be minimized. One such node is the Army CALS test bed, which was published in its initial evaluation of vendor tools to support the CALS standards. The CALS test network will establish a data base of

VUGRAPH 55 - CALS STANDARDS IMPLEMENTATION STEPS (Continued)

evaluation results and a corrective action review board to follow up on recommendations for improved standards and v ndor implementation. Testing of use effectiveness between contractors and DoD Components will also be accomplished when digital data exchange is m de in lieu of hard copy transmission of technical data. A test plan identifying test participants, testing scope and schedules will be available in July 1988 when initial testing of data exchange standards begins.

Through testing, trial contractual applications, and technology development and demonstration, CALS will ensure that its implementations of national and international standards fully meet the needs of DoD and the defense industry.

VUGRAPH 56 - ISSUES

Rights To Data

Not much different than rights in data now.

Security, Privacy, Export Controls

These subjects are not the same.

There are technical approaches available to enhance security, but the human problems will still exist. There are a number of practical issues to be addressed in specific program application. The draft implementation guide has a good discussion on this.

Profit Structure, Investment Precautions

- Profit

  - o Big differences here.

  - o Contractors price now with assumption that they will have sole source support (spares, etc.) for 3 to 5 years - nothing wrong with this - its simply a pricing strategy.

  - o CALS will probably allow earlier breakout - so industry will tend to price higher in the earlier time periods.

- IR&D

  - o We plan to initiate higher grades for CALS related IR&D.

VUGRAPH 56 - ISSUES (Continued)

Source Selection

We are pushing to make CALS a significant consideration for source selection. The draft handbook contains an approach and suggested RFP language in terms of R&M integration with CAD/CAE.

Delivery, Verification, Acceptance

Primarily a government problem. What happens to the DD 250? We will have an electronic signature much like the computer retina scan used in STARTREK. Not a major problem.

Legal Liability

Not really much different here - although an industry concern that they would be liable for issuance of a T.O. originating from an organic initiated change which caused an accident. Most government program managers run organic changes by the contractor.

Cooperative Production (Other Nations)

Will be a problem. CALS standards will have to be adopted by other nations. This will probably take a long time.

DAR, FAR Revisions

Some changes will be needed since they are currently written for the paper world.

ADP Acquisition Revision

Won't be much change since this is still basically controlled by Congressman Brooks.

VUGRAPHS 57 - SUMMARY - BENEFITS

This chart summarizes the benefits from CALS for both DoD and Industry. There is no doubt that CALS will make a significant contribution to increasing the competitiveness of both defense and commercial industry.

DoD will experience productivity gains, but more importantly CALS will improve readiness and shorten lead times. Ultimately CALS will also result in designed in R&M improvements and better configuration management, a frequent problem today, particularly in older systems.

VUGRAPH 58 - CONCLUSION

This vu-graph concludes the presentation. CALS will shortly be a major consideration in most DoD major system and acquisition programs. CALS is an evolving effort which has the support of OSD, the military department, the JLC, and industry. CALS is here to stay. The guidance and capabilities are improving rapidly over time. A list of key contacts is among your enclosures to assist you in obtaining the most recent developments and information.

I'd be happy to answer any questions.

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